

MYCOLOGIA

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WITH 36 PLATES AND 15 FIGURES



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MYCOLOGIA

VOL. XIX

JAN.-FEB., 1927

No. 1

COMPARATIVE MORPHOLOGY OF DOTHIDEACEOUS AND KINDRED STROMATA

WALTER LEROY BLAIN

(WITH PLATES 1-3)

INTRODUCTION

Parasitic fungi with ascigerous stromata have been variously classified by different authors, and important emphasis has always been placed on the structural characters of the stromata and the relation of the stromata to the host, while asci and spores have been considered less significant.

The object of this paper is to make a comparative study of the stromata and of their relation to their hosts, involving many genera and species of parasitic fungi. Forty-six genera with 85 species, of stromatic fungi, for the most part those with ascigerous stromata, parasitic on leaves and stems, have been examined. The fungi were mainly of the Dothideales but other orders and families showing somewhat kindred structures have been included for purposes of comparison. All of the fungi listed in this paper have been studied quite in detail and the observations on them are given as an appendix to this thesis which is filed in the library of the University of Illinois. The forms studied, many of them type specimens, are to be found in the herbarium of the Botany Department of the same institution.

It is realized that from either a taxonomic or phylogenetic standpoint a study of the life history and general development of the stromata is very desirable but time has not allowed a critical consideration of the taxonomic position of the fungi. Each

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specimen has been accepted under the name assigned to it by others, either by packet labels or in printed articles. In cases where there is a difference in the usage of names by different authors the system of Theissen and Sydow (17) has been followed.

In forms as previously described, students have examined, perhaps, a single species, with a preconceived character used in the classification of fungi in mind, and have described the fungus as having this or that character of stroma. In many instances studies have been made with free-hand sections, which of necessity did not reveal the true character of the fungous structure. In the present study serial microtome sections were used, and by examining many species comparative differences or agreements were brought to notice that otherwise would not have been seen. This study of stromatic structure has been helped very much also by the use of Pianezze III b (21) as a stain. With this the young stroma or mycelium stains pink or red according to its age; the very old, dense, dark stroma such as is found in clypeate structures and other fungous masses of similar form does not take up this stain. In intermediate cases, between the old dark stage and the young hyaline stage, the mycelium stains green.

In dealing with the various structures in the morphological units involved in this study it has been necessary, for precision and definiteness, to coin some new words which are marked by an asterisk.

THE GENERAL MORPHOLOGY OF STROMATA

The stromata studied consist of one or more of three fundamental parts:

1. The loculiferous region;* the definite part of the stroma in which the locules are borne (PLATE 1, FIG. 24).
2. The extraloculiferous stroma,* usually homogeneous in nature, which is similar in structure to the loculiferous region and extends beyond it (PLATE 1, FIG. 25).
3. The hypostroma, that part of the stroma which lies imbedded in the host below a superficial loculiferous region, or that portion which lies within the host tissue around and external to the loculiferous region (PLATE 1, FIGS. 26 and 24).

* Denotes new words.

The loculiferous region may be either large and complex (PLATE 1, FIG. 24), or very small and simple (PLATE 1, FIG. 27). In its simplest form it is merely a slight accumulation of pseudo-tissue around, above, or below the border of the locule (*Phyllachora Phaseoli*, PLATE 1, FIG. 27). In its more highly developed form it consists of a large and complex stroma in which several to many locules are borne (PLATE 1, FIG. 24). Loculiferous regions may for convenience be subdivided into two categories: (1) the epistroma, external to the host tissue, and (2) the endostroma, which lies imbedded within the host.

The locules are spherical, flask-shaped, ellipsoidal, or angular in shape. In the normal development the pressure on all sides of a locule is the same, but in *Phyllachora* and other genera, due to the unequal development of the locules, they may be irregularly compressed so as to result in cubical, rectangular, or variously angled locules. They vary greatly in size according to the species, some reaching a height of one millimeter, but usually they are much smaller.

Surrounding the locules is a more or less dense layer of stroma, the border.* This varies in density and thickness in different species of fungi. In some instances it consists of a very dark, dense layer of mycelium, so dense that its structure cannot well be made out, while in other cases it is dense and dark immediately surrounding the locules but shades off in the mesostroma into a lighter and looser structure. In some cases it is dark and dense but blends indefinitely into the surrounding mesostroma, in other instances it is formed throughout of nearly hyaline cells. In some species a definite border is lacking, the pseudo-tissue immediately adjacent to the locule being identical in structure with the mesostroma.

The interior of the locules is usually lined with a soft, delicate, hyaline, somewhat gelatinous layer of fine hyphae which are arranged concentrically, constituting the lining* (PLATE 1, FIG. 28).

The hymenium from which the asci develop either occupies the bottom of the locule or extends over a much larger region, sometimes over nearly all of the interior surface of the locule (PLATE 1, FIG. 29). The hymenium of *Dothidea tetraspora*

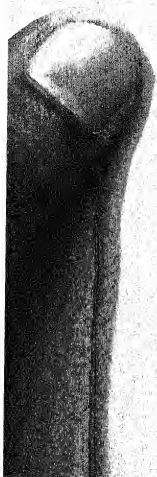
(PLATE 1, FIG. 30) is especially interesting because of its characteristic mammiliform shape.

The asci, which are of various shapes and sizes, and the paraphyses, if present, usually fill practically all of the space in the locules, but in certain species of fungi there is found between the asci a characteristic pseudoparenchyma. The cells of this pseudoparenchyma are relatively large as they occur among the asci but are smaller near the periphery of the locule. In some fungi there is present at the top of the locule a plug,* composed of pseudoparenchymatous cells, occupying the place where the ostiole ordinarily would be (PLATE 2, FIG. 31).

Frequently the loculiferous stroma possesses a rind, composed of a dense black stroma usually two or three cell in thickness (PLATE 1, FIG. 25). This corresponds in function to the cortical tissue of the higher plants and varies in extent from occurring only on top of the loculiferous region, which is usually the case, to extending entirely around it like a band (PLATE 2, FIG. 32).

No definite ostiole, surrounded by a beak lined with periphyses, as is so typically characteristic of the Sphaeriales, has been found in the study of the fungi involved in this paper except in those fungi which obviously belong to the Sphaeriales. In the Sphaeriales there is a definite perithecium present and the ostiole is formed by a few cells next to the top of the central cavity which disorganize and provide a small, free space into which the adjacent cells elongate, turning upward. The disorganization of the cell walls continues and finally the ostiole is completed. In the dothideaceous fungi studied the opening is formed by a breaking away of the stroma above the top of the locule. In the genus *Phyllachora* the locule often extends upward to form a neck and the opening for the discharge of the spores is formed by the breaking open of the stroma above this neck.

The mesostroma,* that part of the loculiferous region exclusive of the clypeus and locules, is either homogeneous or heterogenous in nature. It falls into one of the following categories: (1) a stroma too dense and dark to reveal its cell structure; (2) typically dothideaceous, *i.e.*, having a palisade-like structure (PLATE 2, FIG. 33); (3) a close weft (PLATE 2, FIG. 34); (4) a loose weft (PLATE 2, FIG. 35); (5) a stroma composed of



pseudoparenchymatous cells of no particular form (PLATE 2, FIG. 36); and (6) of long, hyaline, gelatinous cells (PLATE 3, FIG. 37).

The interlocular region,* the stroma between the locules, is usually of structure similar to that of the mesostroma, but it is often somewhat darker and more dense. Also, due apparently to lateral pressure, it more frequently assumes a pseudoprosenchymatous or even a dothideoid character than does the remainder of the mesostroma.

The clypei, which may be epiphyllous, hypophyllous, or amphigenous, vary in form from a very thin, dense, black stroma to a thick, dense, black structure. Usually the clypeus consists of nothing more than the epidermal cells filled beyond recognition with very dark mycelium. Frequently, however, the cells immediately below the epidermis are also filled with the same kind of stroma resulting in a very thick clypeus. In some instances only certain cells of the epidermis are occupied with the dark hyphae resulting in an imperfect clypeus of very characteristic structure (PLATE 3, FIG. 38). The clypeus varies in extent from barely covering the top of the locule (PLATE 1, FIG. 27) to greatly exceeding the loculiferous region (PLATE 3, FIG. 39).

The extraloculiferous stroma, as a rule, is more dense and darker colored than the loculiferous region, in fact so dense in many cases that its structure cannot well be made out. It is usually of structure similar to that of the loculiferous region and is usually homogeneous. It extends beyond the loculiferous region on either side, sometimes to a great distance (PLATE 1, FIG. 25). Extensive development of extraloculiferous stroma is found in only a few fungi, the greater number of those occurring in the Phyllachorineae. In those species of fungi in which the extraloculiferous stroma occurs above the host tissue it is usually divided into two parts: the covering part or rind and the inner part or mesostroma.

The hypostroma, which serves to anchor the loculiferous region in the host, and for purposes of nutrition, may be considered as of two types: (1) The internal mycelium below a superficial loculiferous region; (2) The stroma which lies imbedded in the host tissue around and external to the loculiferous region. No

absolutely definite line can be drawn between the stroma of the loculiferous region and this latter hypostroma as one merges off into the other.

The hypostroma appears in many different forms. In its simplest form it consists merely of very thin mycelial threads which penetrate the cuticle and extend as haustoria into the epidermal cells and sometimes into the mesophyll (*Actinodothis Perottetiae*, PLATE 3, FIG. 40). A slightly more complex form is where thin mycelial threads penetrate into the host and in certain of the epidermal cells develop so as to form very dark masses of mycelium, *Palawaniella Eucleae* (Fig. 3. Bothalia 1: 17. 1921). More often the hypostroma is located in the mesophyll of the host tissue as: (1) loose intercellular mycelium; (2) as more or less compact masses of mycelium in the host cells, in some instances compressed so as to appear as blocks of stroma, and in other cases packing and swelling the cells, causing them to lose their identity; (3) as subcuticular or subepidermal, sheet-like masses of stroma; (4) as a column-like or knobby protruding foot; and (5) as various combinations of these forms. In certain cases the hypostroma appears to be lacking or very inconspicuous.

THE LOCATION OF STROMATA AS REGARDS THE HOST TISSUE

In recording the location of the stromata, upon or within the host tissue, the plan of Theissen and Sydow, with slight modifications, has been followed. They have recognized five different types, namely: (1) superficial; (2) subcuticular; (3) subepidermal; (4) erumpent; and (5) lying within the mesophyll. In my own work I recognize the following types: superficial, subcuticular, epidermal, subepidermal, erumpent-superficial, and lying within the mesophyll. In the subcuticular type of Theissen and Sydow confusion may arise since the mycelium may not only occupy the space between the cuticle and epidermis but quite frequently also penetrates into the epidermal cells partially or entirely filling them. In order to avoid any confusion I subdivide this type and term as subcuticular, the stroma which is actually confined to the space between the cuticle and epidermis, as epidermal, the stroma which partially or entirely fills the epidermal cells of the host, and as subepidermal, such stromata as

lie below the epidermis but are not at all within it. Because of the tendency of the erumpent forms to spread out fan-like and to appear superficial I call that type "erumpent-superficial" corresponding to the erumpent type of Theissen and Sydow.

THE CELLULAR STRUCTURE OF STROMATA

The loculiferous region is composed of pseudoparenchymatous or pseudoprosenchymatous cells though often so dense and dark that it is difficult to determine accurately the component cells. That part of the loculiferous region comprising the mesostroma has many different cell forms. Fungi possessing a dothideaceous stroma have elongated cells that are usually dark colored, thick walled, and are arranged in a palisade-like manner (PLATE 2, FIG. 33). In a few cases, in *Anisochora Tabebuiae* (PLATE 1, FIG. 25) in particular, the stroma is dothideaceous in structure but the cells are light colored and thin walled. In certain instances the stroma is pseudoprosenchymatous, but does not show a distinct palisade arrangement, nor is it composed of long, parallel-walled cells but of cells that are ellipsoid in form (PLATE 3, FIG. 41). Those stromata that possess a pseudoparenchymatous structure have their cells approximately isodiametrical.

The interocular region, which is usually dark in color, is made up of pseudoparenchyma or pseudoprosenchyma, and in most cases when composed of the latter is compressed but sometimes its cells are approximately isodiametrical in form.

The border of the locule is composed of light or dark pseudoprosenchyma or pseudoparenchyma, the cells of which are usually somewhat compressed but none show dothideoid structure.

The rind, usually of two or three cells in thickness, is composed of more or less dark pseudoparenchyma or pseudoprosenchyma.

Inside the locule the lining is composed of very thin, hyaline cells which are closely pressed together and arranged in concentric layers. The interascicular pseudoparenchyma and plug are composed of thin-walled, hyaline, isodiametrical cells much larger in the interascicular region than in the plug.

The extraloculiferous stroma is usually differentiated into two parts, the rind and mesostroma, but is frequently so dense

and dark that it appears as a solid stroma and as a result its cell structure is not revealed. The rind, usually very dense, is frequently composed of dark pseudoprosenchyma, and the mesostroma varies in structure, being the same as that of the loculiferous region.

The cellular structure of the hypostroma is quite varied. In those species in which the hypostroma is developed as a foot* this may be dothideaceous. In *Nowellia guianensis* the central part of the foot is dothideoid, the rest pseudoprosenchymatous, while in *Corynelia portoricensis* it is dothideaceous throughout. In other cases it may consist of either pseudoparenchymatous or pseudoprosenchymatous cells which usually are lighter in color the deeper they penetrate into the host tissue. In some instances the foot consists merely of thin-walled, hyaline, mycelial threads which penetrate into the host tissue.

DISCUSSION

The term stroma was first used by Persoon (14) who used it to describe the structures on or in which are borne the pyrenocarps in the genus *Sphaeria*. Fuckel (8) used the term in the same sense as Persoon and used it in describing the family Dothideaceae. The definition of de Bary (3) which has been followed in this paper differs but little from that of Persoon. De Bary considers stroma as a crust or cushion in which ascocarps are developed. Stroma as used in this article may be quite variable in structure, form and color but it is primarily the matrix on which or in which sexual or asexual fructifications are formed.

Fuisting (9) was the first to use the term epistroma and he considered it as a hyaline pseudoparenchymatous crust formed in the outer layers of the primary cortex of the host which produces conidia. Under this crust a hypostroma, according to him, is produced later in which perithecia develop. Ruhland (15) has used the terms ectostroma and entostroma for these structures following the conception of Fuisting. These terms as used by Fuisting would not fit the Dothideaceae as a whole for there are numerous forms in this family which are not known to produce asexual fructifications. These same terms are used

by Theissen and Sydow to contrast the stroma appearing outside and within the host and it is in this sense that they have been used in this paper.

Many different stages of development of fungous stroma can be recognized by comparison of the figures representing the various stromatic types, and the descriptions of the species studied, in this paper. Inferences or conclusions based on form or structure might seem to be misleading but it is believed from a close study of the fungi involved in this paper that the developmental stages of these forms are as given in the following paragraphs.

The simplest forms, perhaps the most primitive, because of the slight adaptation to their hosts, are those whose stromata are entirely superficial. The stroma varies in complexity ranging from *Dothichloe atramentosa* which is made up of fine, nearly hyaline, gelatinous filaments in the center surrounded by a somewhat loose pseudoprosenchyma which is dothideaceous, to one like *Pauahia Sideroxyli* which has a quasi-dothideoid structure; and finally *Halstedia portoricensis* composed of a very dense pseudoprosenchyma.

At a little higher step in development are the fungi which appear superficial but are fastened to the host by a scant hypostroma. The simplest of these is shown in *Actinodothis Perottetiae* with an extensive epistroma of compressed pseudoparenchyma and a hypostroma consisting merely of thin, hyaline, mycelial haustoria which penetrate into the epidermis and extend for some distance into the host without branching or clumping (PLATE 3, FIG. 40). In *Palawaniella Eucleae* the epistroma is more elementary than that of *A. Perottetiae*, the loculiferous region being, for the most part, composed of paraphyses with a very slight accumulation of pseudoparenchyma at the periphery. But the hypostroma is more advanced, even though consisting of thin mycelial threads, for the penetrating threads enter certain of the epidermal cells eventually filling and packing them with a dense black stroma (Fig. 3. *Bothalia* 1: 17. 1921). A slightly more advanced form is exemplified in *Polystomella costaricensis* which appears superficial but its hypostroma is somewhat more extensive, in that its dark stroma penetrates

certain of the cells of the epidermis. The interior of the epistroma is composed of thin, filamentous hyphae, but the outer part is made up of typical dothideoid stroma.

Another stage in the course of development is represented by those fungi that are subcuticular. It appears that these forms, which are entirely confined to the region between the cuticle and epidermis, represent a more advanced form than those that are largely superficial with a more or less developed hypostroma. *Phaeodothopsis Eupatori* has a well developed subcuticular loculiferous region composed of compressed, linear pseudoprosenchyma while *Anisochora Tabebuiae* (PLATE 1, FIG. 25), *Euryachora betulina* and *Euryachora sp. indet.* are of practically the same complexity, being made up of dothideoid stroma, the former having a somewhat lighter appearance, but none of the four give any evidence of a hypostroma. *Aulacostroma palawanense* (Fig. 7. Phil. Jour. Sci. 9: 177. 1914) is a bit higher in that it has a scant hypostroma in the epidermal cells although the greater part of the loculiferous region is composed of paraphyses.

The fungi which are located in the epidermis represent a still more highly developed stage. In those forms which are epidermal *Catacaumella Gouaniae* is the only one studied that gives no evidence of a hypostroma. Here the endostroma is a well developed dothideoid structure. Of the other three *Trabutia Xylosmae* possesses a pseudoprosenchymatous structure, the hypostroma occurring between the host cells; *Catacauma Zanthoxylonis* is partially dothideoid and the hypostroma is both between and within the cells of the host; while *Phaeochora Neowashingtoniae* is dothideaceous and the hypostroma is within the host cells.

Fungi below the epidermis represent a still greater adaptation. Of those *Phragmocaula viventis*, although being dothideoid, has no visible hypostroma and ranks as the simplest of this group. *Diplochorella amphimelaena* is composed of pseudoprosenchyma and has a hypostroma made up of bead-like mycelium that penetrates between the cells of the host tissue. *Phaeochorella Parinari* has a dothideoid epistroma and a hypostroma composed of light-colored, somewhat delicate mycelium. *Catacauma Ocoteae* has a dark grey pseudoprosenchyma, with a well de-

veloped intercellular hypostroma; *C. palmicola* is composed of compressed, elliptical to linear pseudoprosenchyma; while *Uleodothis Pteridis* has a dothideoid structure. The hypostroma of both occurs within the host cells. *Scirrha rimosa* has a dothideoid epistroma and a hypostroma of much compressed pseudoprosenchyma which gives it the appearance of blocks of stromatic tissue.

A still higher development is seen in the erumpent-superficial types. *Systemma Pterocarpi* with its epistroma and the lack of a definite hypostroma occupies the lowest position. *Dothidina disciformis* is slightly more advanced because of its dothideoid epistroma (PLATE 2, FIG. 32). *Achorella costaricensis* because of its dothideoid, intercellular hypostroma and an epistroma of pseudoprosenchyma comes next. Of the six which have their hypostroma both within and between the host cells *Montagnella maxima* has an epistroma of pseudoprosenchyma and *Achorella guianensis* has an epistroma with a quasi-dothideoid structure. *Nowellia guianensis* and *Yoshinagella polymorpha* stand out from the rest because of the dothideoid central foot. *Coccostromopsis palmigena* and *Dothidella Parryii* possess dothideaceous epistromata and a pseudoprosenchymatous central foot. In the group which has the hypostroma occurring within the host cells *Dothidina costaricensis* stands first in simplicity in that it has no central foot; the epistroma is composed of pseudoprosenchyma with a tendency toward a dothideoid structure. *Achorella Attaleae*, while possessing no central foot, has a dothideaceous epistroma and is a little more advanced. *Schweinitziella palmigena* stands alone because the epistroma is composed of pseudoparenchyma surrounding loosely tangled, hyphal filaments and with a central foot that has a false palisade structure. *Bagnisiopsis peribebuensis* is next in complexity with an epistroma of quasi-dothideoid structure and a central foot of pseudoprosenchyma. The remaining species of this group: *Apiospora carbonacea*, *Corynelia portoricensis*, *Dothidella portoricensis*, *Dothidina palmicola* and *Microcyclus Walsurae* fall in the same category, having a dothideoid epistroma and a central foot.

In the final and highest developmental stage occur the fungi which lie entirely within the mesophyll of the host tissue. The

genus *Phyllachora*, the largest of this group, will be considered in a separate paper later. *Haplotheceium guianense* with its mesostroma composed of a loose hyphal web marks the lowest stage. In the order of their complexity then are seen *Ophiodothella panamensis* with its nearly hyaline, thin-walled pseudoparenchyma; *Phyllachorella Schistocarphae* with a very scant pseudoparenchyma; *Dictyochorella Andropogonis* with a stroma consisting only of a locule border of pseudoparenchyma and a clypeus; *Scolecodothis Ingae* and *Endodothella Tapirae* with a scant mesostroma composed of pseudoparenchyma, the latter considerably darker than the former; *Uleodothis Paspali* with a smoky grey pseudoparenchyma; *Dothidea tetraspora* with a characteristic pseudoparenchymatous mesostroma; *Oligostroma Suttoniae* with a scant mesostroma of pseudoprosenchyma; and *Sphaerodothis sphaerosperma* with a mesostroma of pseudoprosenchyma with a tendency toward dothideoid structure. *Teratosphaeria fibrillosa* with its stroma of light colored mycelium is rather questionable from a taxonomic standpoint. This genus was first placed in the Clypeosphaeriaceae, later removed to the Dothideales by Theissen and Sydow and finally returned to the Sphaeriales. *Desmotascus portoricensis* has both the characters of the Dothideales and the Sphaeriales in that the locules or perithecia are sphaeriaceous when solitary and resemble dothideoid structure when two or three are together. *Dibotryon morbosum* with an endostroma of pseudoprosenchyma and a hypostroma composed of bundles of mycelium between the host cells represents a high stage of development according to Theissen and Sydow because of perithecia and pseudoparenchyma between the asci. *Anthostomella Rhizomorphae* and *A. Rhizophorae* have a definite perithecial wall and a clypeus and belong to the Sphaeriales. *Stegastroma guianensis* falls in the same category and differs from the two mentioned only in the thickness of the clypeus. *Dothidella ribesia* stands out from the rest in that it occurs in the cork tissue of stems and is made up of a characteristic pseudoparenchyma (PLATE 2, FIG. 34).

The Dothideales are, by Theissen and Sydow, set apart from all the other orders by the absence of a perithecial wall and the lack of a definite ostiole. From the lack of a definite perithecium

in the Dothideales it naturally follows that the ostiole, formed by the continuation of the perithecial wall, is absent. Since there is no ostiole the fungi can discharge their spores only by means of some kind of rupture in the stroma above the locules. Some fungi, more especially of the genus *Phyllachora*, showed an ostiolate tendency but in no case was any trace of periphyses noticed as is described for *Phyllachora graminis* by Orton (13).

The genus *Dothidea* was erected by Fries (7) and later Fuckel (8) erected the family Dothideaceae with *Dothidea* as the type genus. In 1897 Lindau (12) erected the order Dothideales with a single family, Dothideaceae. Theissen and Sydow in their monographic work on the order made the distinguishing feature of the Dothideaceae the parallel, pseudoprosenchymatous structure of the hyphae. The Polystomellaceae was erected by them as a family of the Dothideales but later it was removed to the Hemisphaeriales because of the radiate form of the fruiting stroma. However, in the present study of *Polystomella costaricensis* the stroma is seen to be composed of dark, linear pseudoprosenchyma which is typically dothideaceous surrounding loosely tangled, hyphal filaments. This fungus therefore appears to represent a border line form between the Hemisphaeriales and Dothideales.

That typical dothideoid stroma is not always confined to the Dothideales is shown in *Dothichloe atramentosa* and *Corynelia portoricensis*. The genus of the first of these was erected by Atkinson (1, 2) to include the species of *Hypocrella* possessing a dothideaceous stroma. The center of the loculiferous region takes on a filamentous, gelatinous appearance but the outside is composed of stroma that is dothideoid in character. Chardon (5) examined a set of prepared slides made from the type specimen of *Hypocrea atramentosa* and states that the stroma is dothideaceous, and there is no perithecial wall present, but that in the possession of filiform spores and other minor characters it resembles the Hypocreales. He fails to mention what the "minor characters" are, but the presence of filiform spores should not remove this genus from the Dothideales since several genera in that order possess spores of like nature.

The family Coryneliaceae was erected by Saccardo (16) in 1891 to include the genera *Corynelia* and *Tripospora*. Lindau

(12) in his work on the Sphaeriales includes the family in that order. Both of these authors describe the perithecium of *Corynelia* as ostiolate and therefore typical of the Sphaeriales. In my own observations on *Corynelia portoricensis* I failed to see a definite ostiole but attributed this to the fact that the material was too young. However, a definite neck or rostrum develops about the top of the perithecium (PLATE 3, FIG. 42). Fitzpatrick (6) states that his observations have shown that the family lacks the typical ostiole of the Sphaeriales but does possess a mouth or irregularly split opening. He says that the erumpent stroma and the absence of superficial mycelium makes the family unlike the Perisporiales, and the absence of a typical ostiole excludes it from the Sphaeriales. They resemble the Perisporiales more than Sphaeriales in his opinion and he suggests their incorporation in the former order after the limits have been expanded somewhat. However, in the study of this fungus from microtome sections the stroma was found to be typically dothideaceous (PLATE 3, FIG. 42), and fastened to the host by a wide central foot. It might appear as a transition from between the Perisporiales and Dothideales.

There are some fungi which appear to mark a connecting link between the two orders just mentioned. In *Achorella Attaleae* we find that the locules are borne as perithecium-like protuberances on the stroma and that there is a superficial mycelium present. This fungus possessing characters of both orders has an epistroma typically dothideaceous in structure and although showing closest connection with the Dothideales presents a transition form between it and the Perisporiales.

In the key of Theissen and Sydow they emphasize the absence of setae in the genus *Yoshinagella*. However, *Yoshinagella polymorpha* agrees in all particulars with the characters of the genus with the exception of the setae. The presence or absence of setae do not seem to be good characteristics in setting apart a genus and Stevens (20) suggests broadening the conception of the genus *Yoshinagella* and admitting forms with stromatic setae. Comparison of *Y. polymorpha* with specimens of *Asterina comata*, the type species of the genus *Trichodothis*, shows that the stromata and setae are similar and that they are separated only by spore

characters. It appears therefore that stroma rather than setae should be the deciding factor.

The family Pseudosphaeriaceae was erected by von Höhnelt (10) to include the two genera *Weitsteinina* and *Pseudosphaeria* and later he added many more genera. The family was characterized by the presence of pseudoparenchyma between the asci and monoascicular locules. Concerning this von Höhnelt states that it is a noteworthy connecting link between the Dothideales and the Sphaeriales. In their monographic work on the Dothideales Theissen and Sydow, in a supplement, have spoken of the Pseudosphaeriaceae and assigned to it several genera which von Höhnelt had considered as dothideaceous. They divided the family into three groups, namely: Botryosphaeriaceae, Pyrenophoreae, and Dothioreae, and considered it as a highly developed form of the Myriangiales. Later the same authors (18) raised the family to the rank of an order. In the outline of the Pseudosphaeriales Theissen and Sydow state that almost all the forms which they described as belonging to the Dothideaceae possessed an interascicular pseudoparenchyma. In the present study five fungi, namely *Scirrhia rimosa*, *Dibotryon morbosum*, *Desmotascus portoricensis*, *Montagnella maxima*, and *Dothidella Parryi*, possessed this interascicular pseudoparenchyma. Of this number *Dibotryon* was the only genus to be included in the order Pseudosphaeriales. *Desmotascus portoricensis* has been considered by Stevens (19) as belonging to the Sphaeriales. *Scirrhia rimosa* belongs to the Phyllachoraceae, *Montagnella maxima* to the Montagnellaceae, and *Dothidella Parryi* to the Dothideaceae.

In the present discussion the fungi are classed as to complexity of their structure but it does not follow that this is representative of their phylogeny. In the grouping in this article the succession of forms is as follows: (1) entirely superficial; (2) superficial with haustoria; (3) superficial with a scant hypostroma; (4) superficial with a rather well developed hypostroma; (5) subcuticular with no evidence of a hypostroma; (6) subcuticular with a hypostroma that is scant or well developed; (7) epidermal with no evidence of a hypostroma; (8) epidermal with a hypostroma scantily or well developed; (9) subepidermal with a hypostroma scantily or

well developed; (10) erumpent-superficial with or without a definite foot; and finally (11) those which are entirely imbedded within the host tissue. In the order of their complexity as to stromata structure are seen (1) pseudoparenchyma, (2) pseudoprosenchyma, and (3) dothideoid structure. Those fungi with the stroma between the cells of the host have been considered as the most primitive and in order of their complexity are those which are both between and within the host cells, and finally those which are entirely within the cells of the host tissue. The Sphaeriales, because of a definite perithecial wall and ostiole, have been considered higher than the Dothideales, while the Pseudosphaeriales appear to represent an intermediate form between the two orders.

SUMMARY

1. Forty-six genera with 85 species of fungi were examined and compared as to their stromata and to their relation to their hosts. They were mainly of the Dothideales but other orders and families showing related structures were included for comparison.

2. In order to designate the various structures of the morphological units involved in this study some new terms have been coined and they are as follows: border, extraloculiferous stroma, foot, interocular region, lining, loculiferous region, mesostroma, and plug.

3. In studying the structure of the fungi the most salient factors, which serve as distinguishing morphological characters, have been noted.

4. The stromata studied are composed of one or more of three fundamental parts, namely: (1) loculiferous region; (2) extraloculiferous stroma; and (3) hypostroma.

5. The loculiferous region varies in complexity from a slight accumulation of pseudo-tissue, around, above, or below the border of the locule, to a large complex stroma, in which several to many locules are borne. It may consist of either endostroma or epistroma.

6. In certain of the fungi the locules are surrounded by a more or less dense layer of stroma, the border.

7. Some of the fungi possess a rind composed of dense black stroma two or three cells in thickness.

8. No definite ostiole has been found in the study of the fungi involved in this paper except those which obviously belong to the Sphaeriales.

9. Extraloculiferous stromata are found in only a few fungi, the greater number of these belonging to the Phyllachorineae. They usually consist of two parts, the rind and mesostroma.

10. The hypostroma appears in many different forms. It occurs as follows: (1) as very thin, mycelial threads which penetrate the epidermis and extend as haustoria into the host tissue without branching or clumping; (2) as thin mycelial threads penetrating the host and filling certain of the epidermal cells with dark masses of mycelium; (3) as loose intercellular mycelium; (4) as more or less compact masses of mycelium within the host cells; (5) as subcuticular or subepidermal sheet-like masses of stroma; (6) as a column-like or knobby protruding foot; and (7) as various combinations of these forms.

11. In recording the location of stromata upon or within the host tissue the following types have been recognized: (1) superficial; (2) subcuticular; (3) epidermal; (4) subepidermal; (5) erumpent-superficial; and (6) lying within the mesophyll.

12. The loculiferous region is composed of pseudoparenchyma or pseudoprosenchyma of varying density. The cells of the pseudoparenchyma are approximately isodiametrical while those of the pseudoprosenchyma are palisade-like, ellipsoid in form, or long, parallel walled.

13. Nearly all of the fungi examined possessed a concentric layer of thin, hyaline, compressed cells around the periphery of the locule, the lining.

14. Each species of fungus has been classed as to the stroma type to which it belongs and as to the complexity of its structure. With respect to the complexity of structure they have been arranged as to location, density of the epistroma or endostroma, and the position the hypostroma occupies in the host tissue. Those fungi which are entirely superficial have been considered the most primitive, with those that are subcuticular, epidermal, subepidermal, erumpent-superficial, and lying within the meso-

phyll varying in complexity in the order named. Those whose stromata are composed of pseudoparenchyma have been regarded as the simplest types while those made up of pseudoprosenchyma in its various forms have been considered as more highly developed. In the order of its complexity the hypostroma occurs between the cells, both within and between the cells, and finally within the cells of the host tissue.

15. The presence of dothideoid stroma is not confined to the order Dothideales but is found in *Corynelia portoricensis*, which possibly belongs to the Perisporiales, and *Dothichloe atramentosa*, which is in the Hypocreales.

16. Fungi possessing an interascicular pseudoparenchyma, the distinguishing feature of the Pseudosphaeriales, are found in the Dothideales and Sphaeriales.

17. In *Polystomella costaricensis* and *Dothichloe atramentosa* the stroma is composed of loosely tangled, hyphal filaments surrounded by a dothideoid structure. Inasmuch as there is such variation in the same fungus this character is not of high morphological value.

18. *Yoshinagella* is set apart from *Trichodothis* by spore character and lack of stromatic setae. However, since these setae fluctuate considerably in very closely related species of the same genus it seems proper to consider stroma rather than setae as the distinguishing characteristic of a fungus.

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EXPLANATION OF PLATES

PLATE I

Fig. 24. Photomicrograph of *Scirrha rimosa* showing complex stroma with many locules and a hypostroma in blocky formation.

Fig. 25. Photomicrograph of *Anisochora Tabebuiae* showing light colored, thin-walled, dothideoid stroma, and an extraloculiferous stroma.

Fig. 26. Photomicrograph of *Nowellia guianensis* showing a hypostroma, with foot, below a superficial epistroma.

Fig. 27. Photomicrograph of *Phyllachora Phaseoli* showing a very simple stroma and a clypeus just covering the top of the locule.

Fig. 28. Drawing of a locule showing the lining.

Fig. 29. Drawing of a locule showing an ordinary hymenium.

Fig. 30. Photomicrograph of *Dothidea tetraspora* showing a locule with a mammilliform hymenium.

PLATE II

Fig. 31. Locule of *Scirrha rimosa* showing interascicular pseudoparenchyma and plug.

Fig. 32. Photomicrograph of *Dothidina disciformis* showing rind extending entirely around the loculiferous region.

Fig. 33. Drawing showing typical dothideoid stroma.

Fig. 34. Photomicrograph of *Dothidella ribesia* showing hypostroma made up of a close weft.

Fig. 35. Drawing of *Phyllachora Engleri* showing endostroma of loose weft.

Fig. 36. Drawing showing irregular pseudoparenchyma.

PLATE III

Fig. 37. Drawing of *Polystomella costaricensis* showing loosely tangled, gelatinous, hyphal filaments surrounded by dothideoid stroma.

Fig. 38. Drawing of *Phyllachora Trophis* showing imperfect clypei.

Fig. 39. Photomicrograph of *Phyllachora Engleri* showing dense locule border and clypei greatly exceeding the loculiferous region.

Fig. 40. Drawing of *Actinodothis Perottetiae* showing haustoria penetrating the host tissue.

Fig. 41. Drawing of *Dothidina costaricensis* showing ellipsoidal pseudoprosenchyma.

Fig. 42. Drawing of *Corynelia portoricensis* showing neck of perithecium and dothideoid stroma.

FURTHER EVIDENCE OF PHYSIOLOGIC RACES OF OAT SMUTS¹

GEORGE M. REED

In a previous publication (2), I have described the occurrence of physiologic races in both the loose (*Ustilago Avenae* (Pers.) Jens.) and covered (*U. levis* (Kellerm. & Swingle) Magn.) smuts of oats. The facts reported were based on experiments with two collections of each species. One collection of each smut was originally obtained in Missouri and had been used in various experiments during a period of several years. The other two collections were obtained from the Welsh Plant Breeding Station, Aberystwyth, Wales, through the courtesy of Director R. G. Stapledon and Miss Kathleen Sampson. The results of the series of experiments with these four collections gave clear evidence of the existence of specialized races in both species of smut.

The two races of loose smut were characterized by their ability to infect a large number of varieties of oats which were grown in the experiments. The most obvious difference between them was the failure of the race from Wales to cause a severe infection of *Avena nuda* L. var. *inermis*, a variety which has proved to be highly susceptible to the Missouri race. The differences between the two races of covered smut were much more striking. The race from Missouri gave high percentages of infection on a large number of varieties, including *Avena nuda* L. var. *inermis*, *A. sativa* L. var. Canadian, Irish Tan, Monarch, Potato and Victor, *A. orientalis* Schreb. var. Black Tartar and varieties belonging to three sub-species of *A. strigosa* Schreb. These results were quite in harmony with those previously recorded for this covered smut. In contrast, the covered smut from Wales failed to infect any of the varieties of *Avena nuda*, *A. sativa* or *A. orientalis*, which were used in the experiments. In a field test with Victor some infected plants were observed. In view of later results it is probable that the seed of this variety

¹ Brooklyn Botanic Garden Contributions No. 48.

had been accidentally contaminated with some other smut. The Welsh covered smut, however, proved capable of severely infecting cultivated varieties of three sub-species of *A. strigosa*. Perhaps its most outstanding feature was its ability to infect 100 per cent of the plants of *Avena brevis* Roth., a species which had proved entirely resistant to loose smut and only occasionally had given infected plants with the Missouri race of covered smut.

Miss Sampson (5) has recently described some of her experiments with collections of both loose and covered smut from Wales, as well as with material from my collections. In the main her results correspond very closely with mine and the evidence, therefore, is quite conclusive that physiologic host specialization in both species of oat smuts exists.

Additional investigations have been carried out with a large number of collections of both *Ustilago Avenae* and *U. levis* which have been obtained from many sources. As yet it has been possible to test these on only a few varieties of oats. So far as determined most of the collections of smut do not appear to show any marked differences from the Missouri races. It is possible that if the investigations were carried further, involving the use of a wider range of oat varieties, distinctions between some of them might be evident. A few new races, however, of both loose and covered smut have been isolated and some of these are of special interest.

Some of the experiments have been carried out in the greenhouse where specially favorable conditions for infection were available (3). In these tests the usual method was to germinate the inoculated seed in moderately dry sand at a constant temperature of 20° C. After germination the seedlings were transferred to the benches where the plants grew to maturity. In the field experiments, the inoculated seed was sown directly in the ground and, as might be expected, the percentage of infection was usually not as high as in the greenhouse cultures.

PHYSIOLOGIC RACES OF *USTILAGO AVENAE* ON FULGHUM AND RED RUSTPROOF OATS.—In previous studies (1, 4) on the behavior of oat varieties towards the oat smuts, it was found that strains of Fulghum and Red Rustproof consistently proved to be very highly resistant. Several strains of each variety have

been obtained from different sources and they have all shown a similar behavior. Usually no infection was obtained, although occasionally a small percentage of smutted plants was observed. The strains of both varieties have clearly shown a high degree of resistance in previous experiments.

Fulghum and Red Rustproof oats are grown extensively in the southern United States where they are usually sown in the fall. In recent years, selections from them have proved successful in the southern part of the spring oat section. Although these varieties have shown a high degree of resistance to the smuts in our previous experiments, yet it is an interesting fact that in the southern states where they are extensively grown, the occurrence of oat smut in considerable quantities has been reported. It is possible, of course, that much of the smut observed has been on the Winter Turf varieties which are also grown throughout the southern oat section.

With the discovery of specialized races of oat smuts, an effort was made to secure collections of smut from various southern localities with a view to determining whether there are races especially adapted to attacking the Fulghum and Red Rustproof varieties. The quest has been particularly successful, as several collections have been secured which are capable of producing a high degree of infection in one or other of these varieties. The results with these collections are given in TABLE I.²

Three collections have shown a marked capacity for infecting the strains of the variety Fulghum. Collection No. 1 was obtained from Dr. L. R. Hesler of the University of Tennessee, Knoxville, Tenn. The material was received in the summer of 1924 and four experiments were carried out, two in the greenhouse and two in the field in 1925 and 1926. Collection No. 2 was received from Mr. T. R. Stanton, Office of Cereal Investigations, United States Department of Agriculture. The smut was obtained on Fulghum at Lawton, Oklahoma, in June, 1925, and was used in two series of experiments—one in the greenhouse and the other in the field. Collection No. 3 was obtained from Mr.

² It must be emphasized that the statements made regarding the behavior of the varieties apply only to the strains used and numbered in the tables. Other strains of varieties may show a different behavior.

In contrast to the severe infection of Fulghum the strains of Red Rustproof gave negative results. Six strains were grown

in the experiments and only four infected plants were observed in one of them. The variety Burt also proved to be very resistant.

All three of these collections have severely infected *Avena nuda* L. var. *inermis*, *A. sativa* L. var. Black Diamond, Canadian and Early Champion, while Early Gothland, a variety very susceptible to the Missouri race of loose smut, has proved to be only moderately infected and Monarch, a variety very resistant to the Missouri race, has shown a fair degree of susceptibility to all three collections. Black Mesdag consistently remained free from infection and only one doubtful plant of Markton was smutted.

A collection of *Ustilago Avenae* on Red Rustproof oats was also received from Superintendent Dunkle in June, 1925. An experiment in which several varieties were inoculated with these spores was carried out in the greenhouse. Five strains of Fulghum were used and a percentage of infection of 13.7 to 100 was secured. Five strains of Red Rustproof were also used and 30.4 to 55.8 per cent were infected. In view of the fact that this collection of smut gave infection on strains of both Fulghum and Red Rustproof, while the other collection from Mr. Dunkle on Fulghum did not infect Red Rustproof, it was thought possible that the original material may have contained a mixture of smut from the two varieties of oats. Accordingly, spores were carefully collected on both Red Rustproof and Fulghum from this greenhouse experiment and used in a field test, the results of which are given in TABLE I. It is clear from the data obtained that the spores collected on Red Rustproof are incapable of infecting strains of Fulghum, while at the same time causing a more or less severe infection of strains of Red Rustproof. It was further found that the spores collected in the greenhouse on Fulghum produced a severe infection of Fulghum but not of Red Rustproof. The evidence seems clear that the original collection contained a mixture of smutted heads of Fulghum and Red Rustproof.

The data clearly indicate that distinct races of *Ustilago Avenae* attack Fulghum and Red Rustproof oats. The Fulghum race is characterized by its ability to severely infect several

strains of Fulghum and also *Avena nuda* var. *inermis*, *A. sativa* var. Black Diamond, Canadian, Early Champion and moderately Early Gothland and Monarch. Some varieties, as Black Mesdag, Markton, Burt and Red Rustproof, remain free from infection, or practically so. The Red Rustproof race, on the other hand, seems to be confined to the strains of this variety, practically negative results being obtained on all the other varieties grown in the experiment.

COMPARISON OF *USTILAGO AVENAE* AND *USTILAGO LEVIS* FROM MISSOURI.—In previous publications (1, 4) the general similarity in the capacity for infecting oat varieties by the Missouri races of these two smuts has been emphasized. Most cultivated varieties of oats are susceptible to both species and, as a rule, if a variety is susceptible to one species, it is susceptible to the other, and if it is resistant to one, it is resistant to the other. However, several varieties of oats seem to be more susceptible to the loose smut than to the covered, while a very few varieties have behaved in the opposite manner. It has been possible to secure additional data on the behavior of these varieties along with a few which are either highly susceptible or highly resistant to both. The data are presented in TABLE II.

In line with the studies previously reported, such varieties as *Avena nuda*, *A. sativa* var. Canadian, Early Champion and Victor, and most of the varieties of *A. strigosa* proved to be equally susceptible to both races, usually giving practically 100 per cent infection. Black Mesdag, Joannette, Burt, Fulghum and Red Rustproof and one variety of *Avena strigosa* have proved to be extremely resistant to both smuts. There is, however, a group of varieties of *Avena sativa*, including Black Diamond, Black Norway, C. I. 602, Danish, Danish Island, Early Gothland, Green Russian, Irish Victor, Japan, Monarch Selection, Nebraska No. 21, Rossman, Scottish Chief, Trisperma and White Queen, which are susceptible to *Ustilago Avenae*, while giving either negative results or low percentages of infection with *U. levis*. One variety of the side oat group has given a similar result. On the other hand, Monarch has proved to be very susceptible to *U. levis*, while manifesting a high degree of resistance to the Missouri race of loose smut.

TABLE II

COMPARISON OF MISSOURI RACES OF *USTILAGO AVENAE* AND *USTILAGO LEVIS*

Species and variety	Seed No.	<i>Ustilago Avenae</i>			<i>Ustilago levis</i>		
		Total plants	No. inf.	Per cent inf.	Total plants	No. inf.	Per cent inf.
<i>Avena barbata</i> Brot.	830	23	23	100.0	26	26	100.0
<i>Avena brevis</i> Roth.	289	51	0	0	58	3	5.1
<i>Avena nuda</i> L. var. <i>inermis</i>	30	74	71	95.9	60	57	95.0
<i>Avena sativa</i> L.							
v. Black Diamond	116	34	32	94.1	37	4	10.8
" Black Mesdag	70	42	0	0	42	0	0
" Black Norway	118	33	18	54.5	38	0	0
" Canadian	119	56	55	98.2	53	53	100.0
" C. I. 602	145	49	49	100.0	52	8	15.3
" Danish	309	50	50	100.0	57	0	0
" Danish Island	149	17	17	100.0	20	4	20.0
" Early Champion	197	20	17	85.0	24	24	100.0
" Early Gothland	152	62	60	96.7	74	2	2.7
" Green Russian	316	50	34	68.0	58	0	0
" Irish Victor	206	46	46	100.0	50	2	4.0
" Japan	207	85	52	61.1	67	3	4.4
" Joannette	187	47	0	0	53	0	0
" Monarch	161	67	1	1.4	64	63	98.4
" Monarch Selection	162	40	39	97.5	47	0	0
" Nebraska No. 21	280	25	21	84.0	20	0	0
" Rossman	322	47	46	97.8	50	0	0
" Scottish Chief	124	53	20	37.7	59	0	0
" Trisperma	64	40	40	100.0	48	0	0
" Victor	126	32	32	100.0	57	57	100.0
" White Queen	327	36	36	100.0	47	3	6.3
<i>Avena orientalis</i> Schreb.	246	64	62	96.8	69	1	1.4
<i>Avena sterilis</i> L.							
v. Burt	175	10	0	0	15	0	0
" Fulghum	129	49	3	6.1	47	3	6.3
" Red Rustproof	131	39	0	0	41	2	4.8
<i>Avena strigosa</i> Schreb.							
sub-sp. <i>glabrescens albida</i>	587	47	19	40.4	45	38	84.4
" <i>cambrica</i>	588	29	0	0	21	0	0
" <i>orcadensis flava</i>	589	30	30	100.0	19	19	100.0
" <i>intermedia</i>	590	25	24	96.0	18	17	94.4
" <i>pilosa fusca</i>	593	29	26	89.6	21	19	90.4

Occasionally plants of one strain of *Avena brevis* Roth. infected with covered smut were also obtained, although no infection of the species by the loose smut has occurred. *Avena barbata* Brot. has proved to be very susceptible to both smuts.

These results confirm the earlier data as to the behavior of these two smuts on the varieties grown. Although both are capable of attacking a large number of varieties belonging to the different species of oats yet they can be differentiated by differences in their capacity for infecting certain varieties.

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BROOKLYN, N. Y.

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SCOLECOBASIDIUM, A NEW GENUS OF SOIL FUNGI

E. V. ABBOTT

(WITH PLATE 4 AND 1 TEXT FIGURE)

While making a study of the fungous flora of Louisiana soils, two fungi were isolated quite commonly which did not seem to belong to any genus of fungi now described. On the medium used for isolating fungi from the soil, an acidified synthetic agar, these organisms appeared as small brownish to black colonies, at first almost entirely submerged, but later developing aerial mycelium and producing conidia. They were isolated from both cotton and sugar cane soils.

The distinguishing characters of these fungi are the shape of the conidia and the method of bearing the conidia on the conidiophores. The conidia of one species, *Scolecobasidium terreum* (TEXT FIG. 1-a; PLATE 4-A), are T- or Y-shaped, while those of *S. constrictum* (TEXT FIG. 1-b; PLATE 4-B) are oblong with a constriction in the center. The conidia of both are two celled and lightly olivaceous.

The type of conidia production is the same in both species (TEXT FIG. 1-a, c). From the ends of the short conidiophores one, two, or three short, thread-like sterigmata arise, each of which bears a terminal conidium. The thread-like nature of the basidia or sterigmata suggested the term *Scolecobasidium* as a generic name.

When the classification of these fungi was first being considered, there was some question as to whether both could be classified properly in the same genus in view of the shape of the conidia. *Scolecobasidium terreum*, which has T- or Y-shaped conidia, might be considered as belonging to the Dematiaceae-Staurosporeae, while the shape of the conidia of *S. constrictum* places it in the Dematiaceae-Didymosporeae. However, the type of fructification and of conidia germination, which are identical in the two (TEXT FIG. 1-b, d), and the similarity in the colony

characteristics of the two organisms, show them to be at least very closely related forms. Since the point in question is largely a matter of opinion, they were classified in a single genus, which the author would place with the Dematiaceae-Didymosporaeae.

Scolecobasidium gen. nov.

Hyphae creeping, septate; conidiophores arising as short side branches from aerial hyphae, not erect, non-septate. Conidia elongate, two celled, smooth, light olivaceous to almost hyaline, borne singly on short, terminal, thread-like sterigmata; one to three sterigmata on each conidiophore.

Type species: *Scolecobasidium terreum*.

1. *Scolecobasidium terreum* sp. nov.

Cultivated on dextrose bean agar, colonies round, 2-3 cm. in diameter; surface velvety, olivaceous; reverse greenish black. Hyphae light olivaceous, septate. Conidiophores 5.0 to 8.0 μ

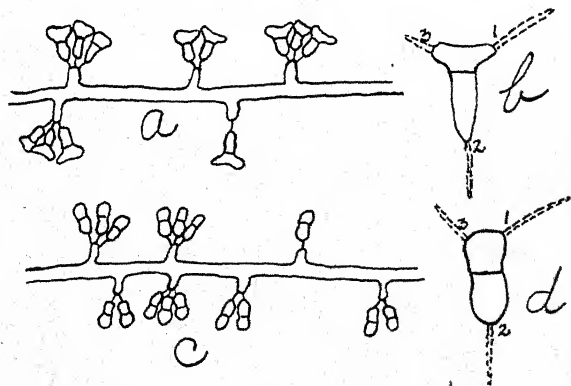


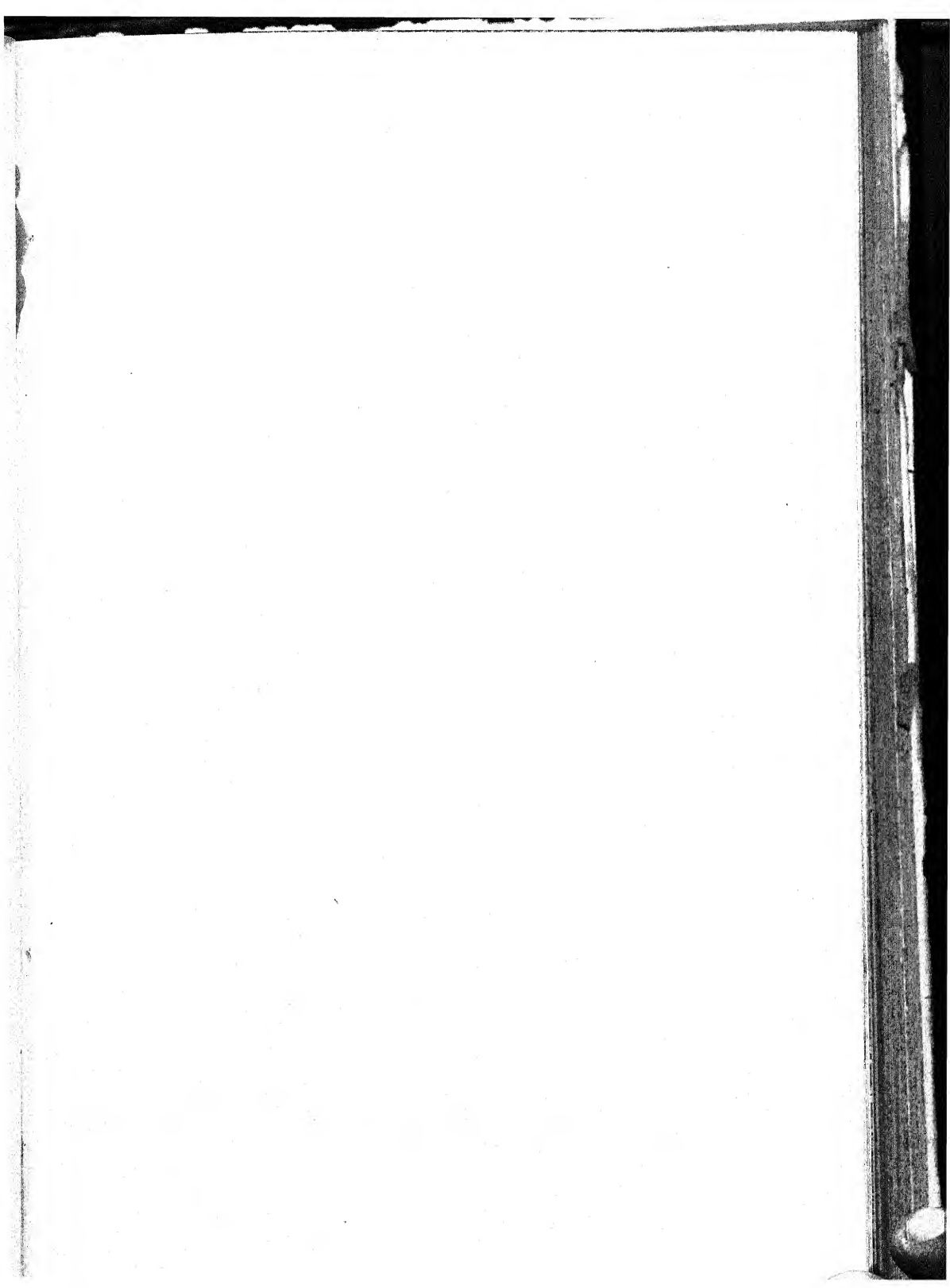
FIG. 1. *a, b-Scolecobasidium terreum*, *a*, conidiophores; *b*, germination; *c, d-Scolecobasidium constrictum*, *c*, conidiophores; *d*, germination. 1-3. germ tubes.

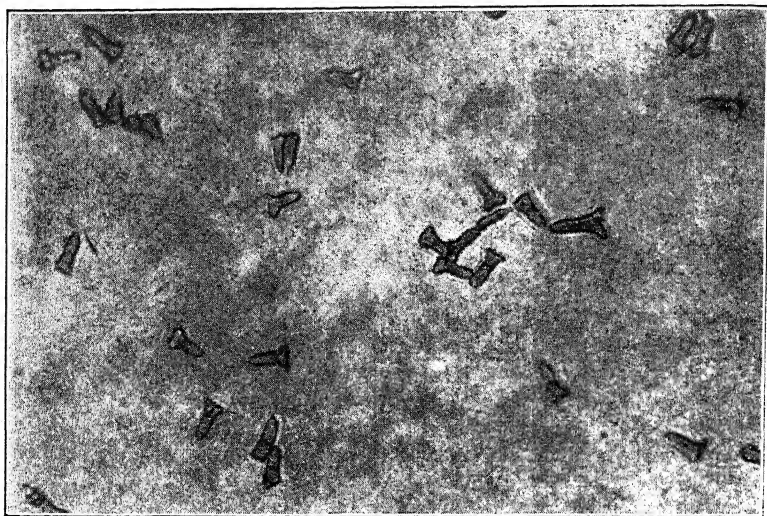
long by 2.0 to 2.5 μ wide. Sterigmata 0.5 to 1.0 μ long. Conidia T- or Y-shaped, two celled, light olivaceous to almost hyaline, smooth, 4.0 to 12.0 μ long by 2.0 to 2.5 μ wide. Perithecia or sclerotia not observed (TEXT FIG. 1-*a*; PLATE 1-*A*).

HABITAT: soil.

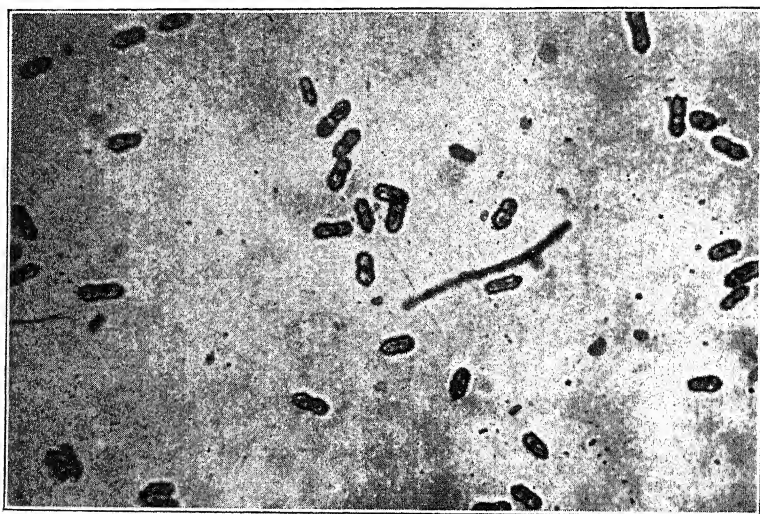
2. *Scolecobasidium constrictum* sp. nov.

Cultivated on dextrose bean agar, colonies round, seldom more than 3 cm. in diameter; surface fuscous, olivaceous; reverse





A



B

- A. *SCOLECOBASIDIUM TERREUM*
B. *SCOLECOBASIDIUM CONSTRICTUM*

greenish black. Hyphae light olivaceous, septate. Conidio-phores 5.0 to 8.0 μ long by 2.0 to 2.5 μ wide. Sterigmata 0.5 to 1.0 μ long. Conidia two celled, slightly constricted at the center, smooth, light olivaceous, 6.0 to 12.0 μ long by 2.5 to 4.0 μ wide. Perithecia or sclerotia not observed (TEXT FIG. 1-c; PLATE 1-B).

HABITAT: soil.

On Czapek's synthetic agar the growth of these fungi is slower and less abundant than on dextrose bean agar. The optimum temperature for growth is between 25° and 30° C. Slight growth occurred as high as 35° C., with no growth at 37° C.

The author is indebted to Dr. C. W. Edgerton for suggestions regarding the classification of the fungi described and for making the photomicrographs.

LOUISIANA AGRICULTURAL EXPERIMENT STATION,
BATON ROUGE, LOUISIANA

EXPLANATION OF PLATE 4

Photomicrographs of conidia of *Scolecobasidium*: A, *S. terreum* ($\times 825$); B, *S. constrictum* ($\times 675$).

MYXOMYCETAL MISDEMEANORS

THOMAS H. MACBRIDE

Myxomycetes are generally reckoned entirely inconsequential. Retiring in habit, obscure in structure, they are ignored by the ordinary student, and seldom collected. Apparently, innocent to a degree;—save that a single species sometimes may affect the statistics of the cabbage-field,—of service nowhere, economic importance is nil, and applied science holds them in disdain; why mention them?

But our students of practical botany are zealous people; watchful are they; on the lookout always for the welfare of field and garden, noting especially symptoms new; and, singularly enough, the slime-moulds now no longer may escape!

Recently there came to judgment from Kentucky material correctly diagnosed as representing the group in question. One specimen from a lawn or blue-grass pasture carries on the blades and stems of *Poa* typical *Physarum vernalum* Somm. The other shows the starting shoots ('sets'?) of the sweet-potato, *Ipomæa*, overwhelmed apparently by a fruiting plasmodial phase of *Physarella*, doubtless *P. oblonga* (Berk. & Curt.) Morg.

This is surprising. The small *Ipomæa* must have been almost smothered, and,—if Sir Jagadis may be assumed to know anything about it at all,—at the same time nearly tickled to death! Think of a gelatinous, tortuous stream slowly creeping over every exposed, transpiring surface!

But greater was the surprise indeed when a few days later,—in fact, before the clear identification of the formless, tangled, capillitial mass that whitened the withered leaflets of the Kentucky *Ipomæa*,—a letter arrived announcing specimens from Mississippi 'under separate cover.'

Upon examination these proved to be precisely the same species on almost identical hosts, viz., on *Ipomæa* as before, and on a species of grass, *Paspalum* for *Poa*, perhaps *P. platycaule*, a valued lawn-grass in some regions.

The coincidence now becomes the thing of interest. Are we in presence of a shaping habit, or is it some established relation until now overlooked?

So far as appears, of course, it all comes about as part of the ordinary experience of a myxomycete. Daylight the slime-mould needs not, at least for a time, if ever. For shelter and moisture it seeks the sunless regions of decay. For the *Physarum* named the rotting mat of smothered grass-leaves of turf, or lawn well-watered and enriched by constant clippings furnished ideal habitat. There the myxo may flourish all unsuspected, spreading sometimes quite equally in all directions, until maturity, when, urged perhaps by necessity for air,—the oxidation called for in spore-formation,—the plasmodium suddenly seeks the light, ascends everything climbable. Stiff, upright stems and leaves of lawn unshorn, just right, soon to be covered with hundreds of tiny sacs, each packed with uncounted, black, microscopic spores, so that when the belated gardener arrives,—perhaps in the sunny afternoon,—there rises about his flying blades sudden clouds of dust, like sooty smoke. 'Something wrong,' he's sure to say; and when, his mowing ended, he goes back to see, lo! a black shadow on his shearing, a dusky ring a yard or two in diameter, a 'fairy ring' in fact, perhaps two or three of them; the *Physarum* has done its work. 'Smut,' the gardener says, and makes report; but the grass is none the worse,—not one whit!

The case of *Ipomæa* is much the same. Here the soil is tilled; but enriched perchance with leaf-mold, or decaying vegetable matter of some sort. On a mass of this beneath the surface, the plasmodium forms, later shaping its fruit above ground as before, on anything that there may lie. No doubt the movement (growth) of the potato-shoot greatly disturbed the easy procedure of its guest, so that not a single normal sporangium came to form!

In this case the young sweet-potato is possibly injured, growing points checked or killed; but the situation is hardly pathologic; it is the accident of one organism for the moment getting in another's way, the embarrassment apt to be mutual.

Should an entire row or field be affected, we should have occa-

sion for investigation; even that two cases should be reported, wakens desire for further information; symbiosis?

However;—misdemeanors of the sort here brought to view are not infrequent; but seldom do they provoke inquiry. A plant in bloom, two or three feet high, has been seen completely covered with the sporangia of *Physarum polycephalum*; *Mucilago* likes to climb the smooth stems of *Impatiens pallida* by the lake or stream; *Diachea* occasionally covers a small strawberry-patch, soiling with standing spore-case dozens of scarlet globes to the undoubted vexation of the owner. *Physarum cinereum* is also sometimes found in similar compromising situations; *Diderma simplex* on the cranberry, and various didermas and physarums affect the sedges, and crowfoots, marsh-mallows, etc., in moist ground everywhere.

But so far the misdemeanors of the myxomycete are almost negligible. Accidents they are; mere incidents in nature's wide conflict irrepressible, where every living thing is forever getting in the way of everything else that lives and grows.

IOWA CITY, IOWA

MYCETOZOA FROM PORTO RICO

ROBERT HAGELSTEIN

The following species of slime-molds were collected by the writer, while on a visit to Porto Rico, during the early months of 1926, in the company of several members of the scientific staff of the New York Botanical Garden. The greater part of the collections were made in the vicinity of San Juan, and there, at the time, the weather conditions were not favorable. The rains had ceased by December 1925, and as an interval of seven weeks of very dry weather had intervened, the fruitings in many instances were old, and much weathered, making identification difficult.

The number of species found was not large, but it is interesting to note that about one half of them were unrecorded from Porto Rico prior to this visit. It is the writer's opinion that systematic and frequent collecting by resident students who have opportunities to follow the weather's vagaries would lead to the discovery of many more species in this tropical island. It is apparent that little intensive collecting in this group has been done in Porto Rico.

The material was submitted to Dr. W. C. Sturgis, an eminent student of the Mycetozoa, for verification, and determination of obscure species and imperfect specimens. To him the thanks of the writer are due, as well as to Dr. N. L. Britton, Director of the New York Botanical Garden, Dr. B. E. Quick, of Westminster College, New Wilmington, Pa., and Mr. R. A. Toro, of the Insular Experiment Station, Rio Piedras, Porto Rico, for valuable assistance in the field.

The species unrecorded from Porto Rico prior to 1926 are marked with an asterisk.

1. *FULIGO SEPTICA* (L.) Gmel.

On dead wood, San Turce, Guaynabo and Rio Piedras.

2. *PHYSARUM MELLEUM* (Berk. & Br.) Mass.

On leaves and twigs, Guaynabo.

3. *PHYSARUM COMPRESSUM* Albert. & Schw.

On leaves and twigs, Guaynabo.

*4. *PHYSARUM POLYCEPHALUM* Schw.

On dead wood, Hacienda Anon.

*5. *PHYSARUM NUTANS* Pers.

On leaves and twigs, Guaynabo.

The sporangia have unusually long stalks and delicate capillitium.

*6. *PHYSARUM RENIFORME* (Mass.) List.

On dead wood, Coamo Springs.

*7. *PHYSARUM SESSILE* Brandza.

On leaves, Guaynabo.

Miss Lister (Monog. Mycet. Ed. 3, p. 55, 1925) says that this species was formerly regarded as a plasmodiocarp form of *Physarum variabile* Rex. The Porto Rican material, which is very scanty, has lime knots and spores similar to Brandza's species, but the general appearance is not the same. It inclines more to definite sporangia, and may be *P. variabile*. Further collections are needed for positive determination.

8. *DIDYMIUM SQUAMULOSUM* (Albert. & Schw.) Fries.

On leaves, Guaynabo.

A variable species. Among a number of gatherings, one shows extremely long stalks.

9. *DIDYMIUM NIGRIPES* (Link) Fries.

On leaves, Guaynabo.

Also, a variable species. Several fruitings were found, all with dark stalks. One seems to be quite typical; another has a small, dark, rough columnella; a third has a large white columnella.

*10. *DIDERMA HEMISPHERICUM* (Bull.) Horne.

On leaves, Guaynabo.

*11. *STEMONITIS HYPEROPTA* Meylan.

On mossy log, Cidra.

This species is described by Miss Lister (Monog. Mycet. Ed. 3, p. 134, 1925) as including two small spored heretofore recognized varieties of *Comatricha typhoides* (Bull.) Rost. The Porto Rican specimen has spores 4.5μ in diameter. The reference to *S. hyperopta* is somewhat doubtful.

12. *COMATRICHA LONGA* Peck.
On dead wood, Mayaguez.
- *13. *COMATRICHA IRREGULARIS* Rex.
On dead wood, Guaynabo.
- *14. *LAMPRODERMA VIOLACEUM* (Fries) Rost.
On mossy log, Cidra.
- *15. *LAMPRODERMA ARCYRIONEMA* Rost.
On herbaceous stalks, Guaynabo.
- *16. *CRIBRARIA INTRICATA* Schrad.
On dead wood, Guaynabo.
- *17. *CRIBRARIA VIOLACEA* Rex.
On twigs, Guaynabo.
18. *DICTYDIUM CANCELLATUM* (Batsch) Macbr.
On dead wood, Guaynabo.
19. *LYCOGALA EPIDENDRUM* (Buxb.) Fries.
On dead wood, Mayaguez.
- *20. *OPHIOTHECA WRIGHTII* Berk.
On dead wood, Guaynabo.
21. *ARCYRIA DENUDATA* (L.) Sheldon.
On dead wood, Guaynabo.
22. *ARCYRIA CINEREA* (Bull.) Pers.
On dead wood, Guaynabo, Cidra.
23. *HEMITRICHIA CLAVATA* (Pers.) Rost.
On twigs, Guaynabo.

MINEOLA,
NEW YORK.

NOTES AND BRIEF ARTICLES

Just as this was going to press we received an announcement of the death of Dr. Curtis G. Lloyd on Thursday, November 11, at his home in Cincinnati. Further details of his life and work will appear in a later number of MYCOLOGIA.

We learn from one of the local newspapers that Dr. John Dearness, Associate Editor of MYCOLOGIA from its beginning, has recently been awarded the degree LL.D. from the University of Western Ontario. The readers of MYCOLOGIA will doubtless all be pleased to know that this added honor has come to one of our oldest mycologists.

In Notes on Parasitic Fungi in Wisconsin XIII, there is an error on p. 172 that should be corrected. In the third line above the figure "2593" should be 3491. Fungi Columbiani 2593 was correctly labeled *Tuberculina Davisii* Sacc. & Trav. but 3491 was not. J. J. DAVIS.

A MONOGRAPH OF THE BRITISH LICHENS

The above is the title of a descriptive catalog of the species of lichens in the Department of Botany in the British Museum (Part II) by Annie Lorrain Smith, F.L.S. It is stated in the preface that the long interval between the publication of parts I and II has been caused by the continued ill-health and death of Rev. James Crombie. Miss Smith has used his manuscript and so far as possible followed his form. The book contains 447 pages of text and 63 plates showing the diagnostic characters of the species treating. This part contains the Graphidaceae and the Pyrenulaceae.

AMANITA SOLITARIA

This very large and very handsome species occurs abundantly in the dry oak woods of Virginia and adjoining states from mid-

summer until October. It is usually white and covered with powder and large warts, the stipe being concolorous and very thick at the base, where it is often prolonged into a root-like projection.

The abundance of this species at Lynchburg, Virginia, during the past two summers, which were exceedingly dry, set me to thinking and experimenting. I found that the large swollen base of the hymenophore is a water reservoir, and on this account the unexpanded pileus can endure drought for weeks, waiting for a rainy spell to continue its development.

Even after partial expansion, the covering of powder and fine scales protects the plant from drought as fine hairs protect foliage. It is also provided in most cases with a distinct odor of chlorine or chloride of lime, which keeps most insects away and allows the pileus many days in which to disseminate its spores.

It is a great pity that such a splendid mushroom is not edible. What fine messes one could have when few other mushrooms could be found! Many of the caps are over six inches broad, and only a few of them would make a meal. To be sure, it is only slightly poisonous and McIlvaine took a chance on it, but the stomachs of ordinary mortals might not be so well fortified.
W. A. MURRILL.

NOTES ON FLORIDA FUNGI

Seeking a milder climate for recuperation after a severe illness, the writer spent the months of March and April, 1926, on St. Andrew's Bay in Florida. As a needed exercise in outdoor life the study of phytobiology was undertaken as more to his taste than golf or fishing.

The fungous flora of the region at that season of the year was found to be rather sparse. The few specimens observed were mostly of tough species or old and weathered specimens. Occasionally in some moist, deeply shaded hollow a prostrate tree of *Magnolia* or *Quercus* would be found bearing an abundant crop of several cosmopolitan species, such as *Stereum versicolor*, *Polyporus hirsutus* Wulf. and *Polyporus arcularius* (Batsch) Fries. The Bay is shut off from the Gulf by a long, narrow sand spit, on the inner side of which a large pine log lay partly buried in

the sand as though cast upon the shore by some storm. This bore a number of unusually large masses of *Lenzites saepiaria* Fries one of which was an imbricated mass on the end of the log, $4 \times 10 \times 12$ cm. in size.

St. Andrew's Bay lies in what is known topographically as the coast flatwoods. The region is low, but a few feet above the sea-level. The surface is slightly undulating and so near the water-table that many of the depressions are wet or filled with shallow ponds only a foot or two deep. As the soil is chiefly a loose, porous sand through which the water readily passes, the slight elevations are commonly dry and often more or less sterile, but the depressions frequently contain a considerable accumulation of alluvium forming a rich moist loam. Under these conditions one passes in a few rods from dry sandy areas of scrub oak and pine to moist and dense almost tropical-like jungles. These latter occupying the depressions are commonly known as "titis" and are usually characterized by a dense growth of *Cliftonia*.

In several widely separated places were found specimens of *Clathrus columnatus* Bosc. which would seem, therefore, to be a fairly common species in this region for one of the Phallales or stinkhorns. The plant seems to be chiefly confined to the drier sand areas. One was found among the sand dunes along the Gulf shore. At Lynn Haven, in one dooryard of almost barren and very loose sand, these plants came up at frequent intervals for weeks and I was informed had been observed in the same spot for at least two years as they had been very annoying to the housewife on account of their disagreeable odor. The mycelium would, therefore, appear to be perennial, but it is possible that there were successive crops through seeding by means of ground beetles.

The plants, as is the case with many of the fleshy fungi, spring up more frequently after a rainy night, but "eggs" were observed apparently on the verge of eruption that passed through two or more heavy rains before the receptacle finally burst through the volva. It is evident that showers do not induce eruption until the plant has fully developed. In fact, I am disposed to think that dry weather retards the eruption more than wet weather hastens it. If the shower does not come at the opportune time

the plant soon bursts through the volva, but is less successful in the display of its characteristic features and is not so likely to attract attention. Those that opened during a dry spell were apt to be small and distorted and were frequently hindered in their erection by dried portions of the volva adhering to the receptacle.

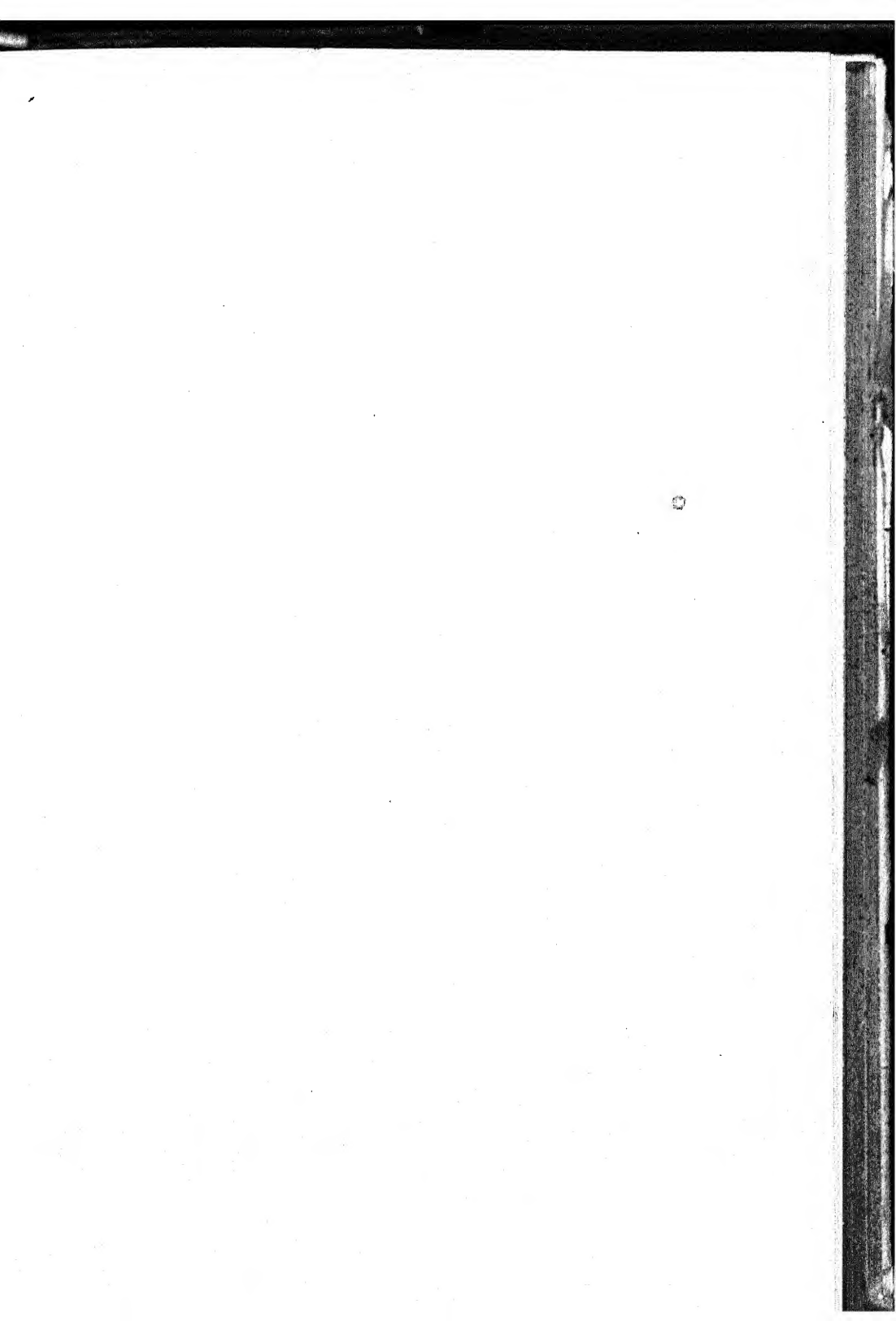
Clathrus when fully developed is characterized by four crimson bars or columns arising from the central base of the volva, curving outward and up, then converging and finally uniting at the top in a four-sided arch on the underside of which and on the inner face of the top of the bars is the slimy spore-bearing gleba. The plant appears to be quite variable and several species have been described which are probably only growth variations. One remarkable form was observed among the plants which came up in the above described plot and doubtless from the same mycelium, otherwise we might well have supposed it to be a distinct species. Instead of four bars there were eight and these united at the top in pairs, forming a row of four separate arches. In another specimen two transverse bars were present, each uniting two of the vertical bars at about half their height.

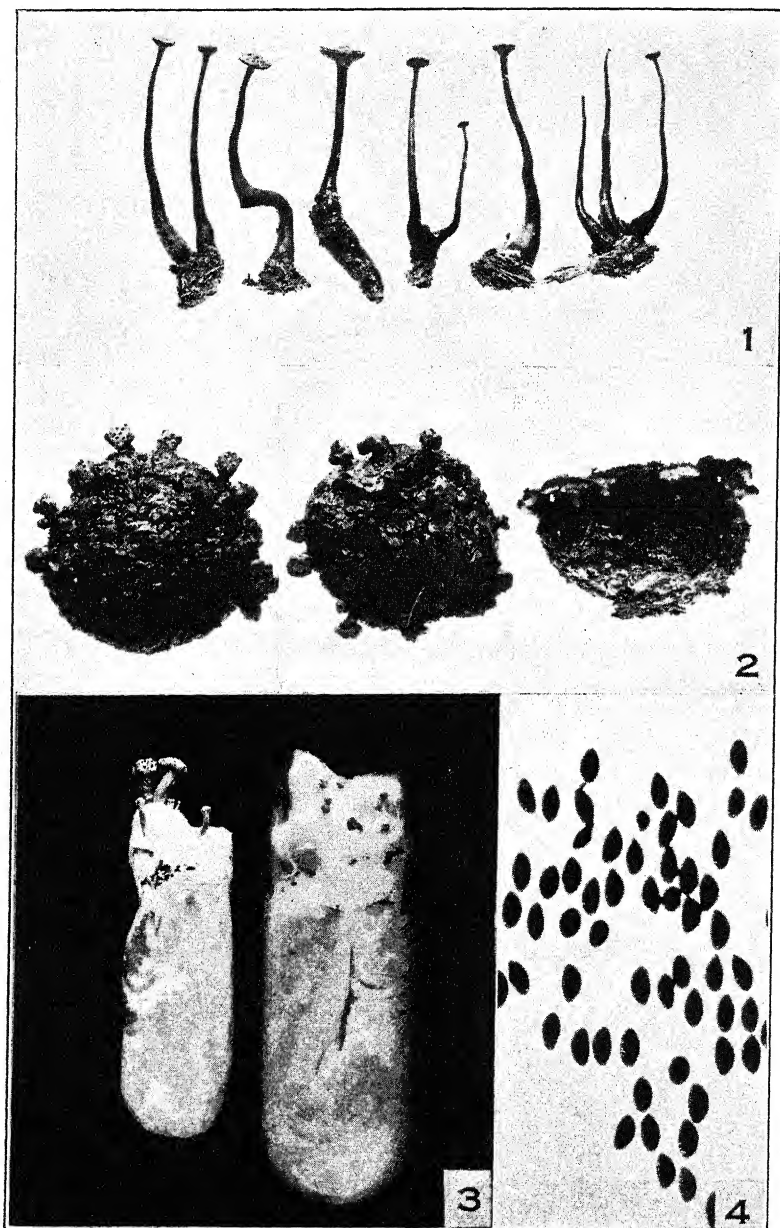
If the plants are not collected within two or three hours after the volva opens there will usually be found within the receptacle several black ground beetles, apparently scarabaeids, feeding ravenously on the softer portions. Even without the aid of these beetles the plant soon decomposes and a specimen was never observed the second day after eruption. Until eruption the "eggs" are very persistent for many days regardless of the changes of weather.

In the same dry sand area were observed a number of puffballs, evidently *Astrea hygrometricus* (Pers.) Morg. and what appeared to be *Lycoperdon Peckii* Morg. Also the old base of a remarkably large *Scleroderma Geaster* Fries was found half buried in the sand and on the trunk of a prostrate palmetto was detected a cluster of sporophores of what I suppose we must consider the very common *Schizophyllum commune* Fries, although, when found in the fresh state, it was difficult to believe that this was the same plant so often seen in the North. The dried specimen,

however, assumed a more normal appearance. I have not found it recorded on palmetto.

These were practically all the larger fungi observed with the exception of several fine specimens of *Polyporus sanguineus* (L.) Fries perhaps too near the northern *P. cinnabarinus* (Jacq.) Fries but of thinner texture. HOWARD J. BANKER.





PORONIA LEPORINA

MYCOLOGIA

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MARCH-APRIL, 1927

No. 2

STUDIES ON BERMUDA FUNGI—I PORONIA LEPORINA

F. J. SEAVER, H. H. WHETZEL AND CYNTHIA WESTCOTT

(WITH PLATE 5 AND 5 TEXT FIGURES)

Toward the close of our recent collecting expedition in the Bermuda Islands (January 11 to February 13, 1926) a fungus was collected which was of more than usual interest. This collection was made by the senior author on Grace Island, a small island in

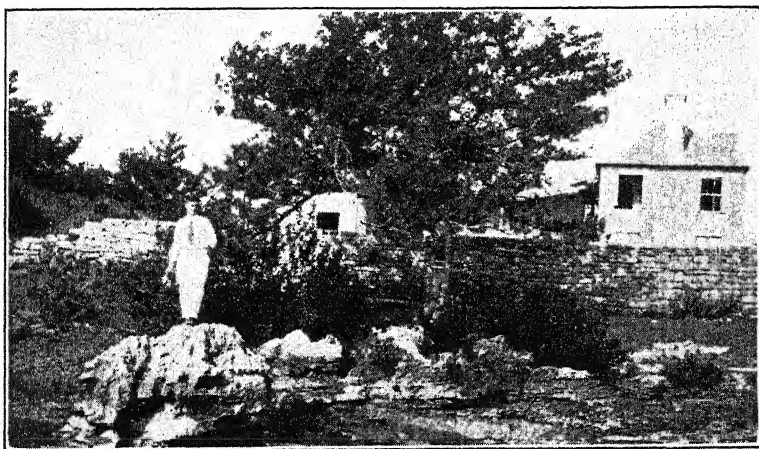


FIG. 1. Shore line on Tucker Island near Grace Island, Bermuda, showing old residence and Bermuda cedars.

Hamilton Harbor, where a day was spent as the guests of Mr. Thomas Godet who very kindly placed himself and his motor boat at our service. Tucker Island, which has a single residence now deserted and partially in ruins so that the island is un-

[MYCOLOGIA for Jan.-Feb. (19: 1-42) was issued Jan. 1, 1926]

inhabited, was also visited by us on this occasion. The trip to these islands was made at Mr. Godet's suggestion and primarily for the purpose of studying the diseases of the "prickly pear" cactus.

While Mr. H. K. Lewcock of Australia, who accompanied us on this expedition, spent his time making observations on the diseases of the cacti, the mycological members of the party (Mr. L. Ogilvie and the senior writer) spent their time hunting for fungi. A number of interesting collections were made, among them, a species of *Tylostoma*, a stalked puffedball, a genus no species of which had previously been recorded for the Bermudas; a fine collection of *Geaster*, the species not yet determined; and *Lamprospora miniata*, a species previously found on the main island of Bermuda.

The fungus which has prompted the writing of the present paper is a species of *Poronia* (PLATE 5, FIG. 2) collected in quantity on the excrement of rabbits which appeared to be very abundant on this particular island. One species of *Poronia*, *Poronia Oedipus* (PLATE 5, FIG. 1) has been very commonly collected not only in Bermuda but in nearly all of the tropical islands visited by the writers. That species occurs on the excrement of cattle. No other species of *Poronia* has been found in Bermuda up to this time. The species on rabbit dung was new to the writers and naturally excited their interest.

Immediately on returning home, the records were checked over in order to find out what species of *Poronia*, if any, had been reported on this substratum. We found that Ellis and Everhart had collected such a species at Emma, Missouri, in 1889 and distributed it in *North American Fungi*, 2354 (see *Proc. Acad. Nat. Sci. Phila.* 1890: 229).

In the herbarium of The New York Botanical Garden there is a drawing from the Massee collection apparently by George Massee labeled *Poronia leporina* Ellis and Everhart with the following note attached: "On rabbit dung, Cadeby, Yorks.—first record for Europe." There is no specimen accompanying this drawing. So far as we are aware, the original collection from Missouri and Massee's sketches of the specimen taken in England comprise our complete knowledge of the distribution of the species. Its

occurrence therefore in one of the small islands of the Bermudas is surprising.

One will naturally say that the species is widely distributed but has been overlooked by collectors. This does not seem to us to be a satisfactory explanation since the same collectors who found it in Bermuda would have been just as likely to find it in any of the other tropical islands or in the mainland for it is not too small to be easily seen. It is quite possible that it is not a true tropica

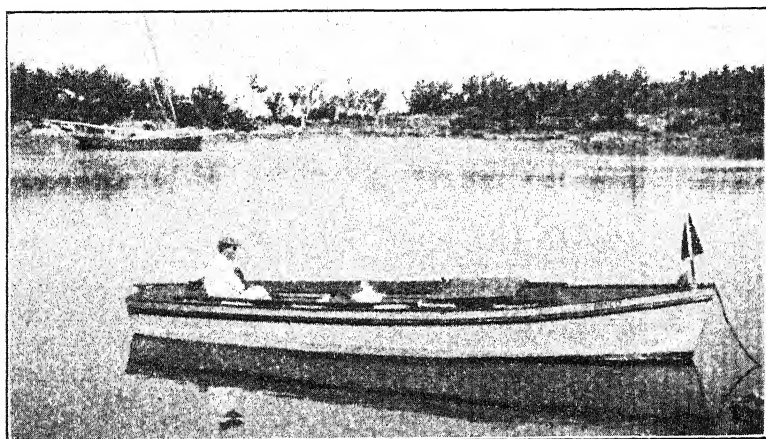


FIG. 2. Getting ready to leave Tucker Island at the close of the day.

species but is restricted to the warmer regions of the temperate zone. We will leave the readers to offer other explanations of this peculiar distribution.

The fungus occurs abundantly on Grace Island, as many as a half dozen or more stromata growing on a single pellicle of the dung. A large collection was made and a quart or more could easily have been secured if one had taken the time. After we had collected a goodly quantity of the material Mr. Godet informed us that rabbits were still more numerous on one of the neighboring islands. We went to this island and spent what time there was left searching for this and other objects of interest but to our surprise we found none of the *Poronia* on this island. Our failure to do so may have been partly due to lack of time but we feel certain that if the fungus were as abundant on the last island as on Grace Island we could not possibly have missed it, since a

special search was made for it. The species was tentatively determined by us and later submitted to Dr. C. L. Shear who reported that in his opinion it was identical with the Ellis and Everhart species.

The Bermuda material shows a relatively wide range in size of the stromata. They vary in height from one half mm. or less up

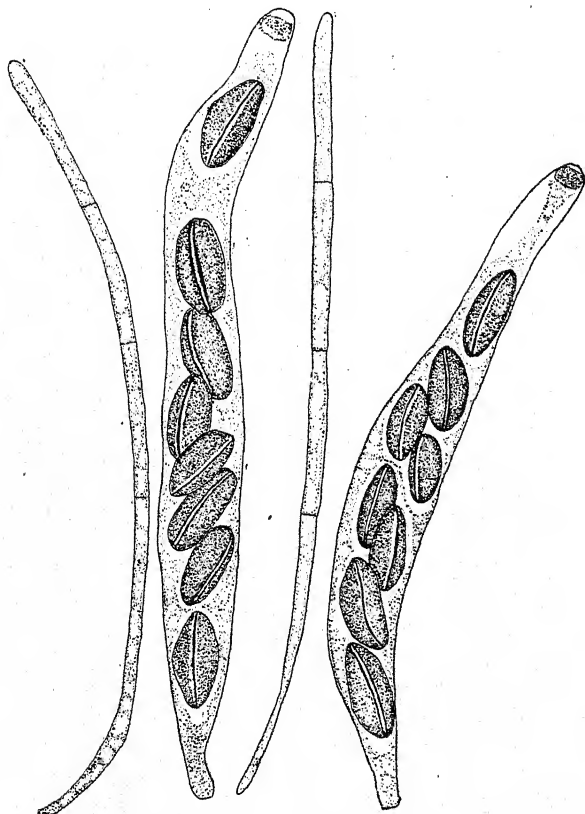


FIG. 3. Asci, ascospores and paraphyses. $\times 700$.

to 3.5 mm., the majority being about 2 mm. The stipes are rather stout, averaging about .5 mm. in diameter. The stromatal caps are irregularly discoid, ranging from .5 to 3 mm. in diameter, most of them being from 1.5 to 2 mm. broad. The stromata are light tan in color, sometimes with a reddish tinge, the stipes usually of a somewhat lighter shade than the discs.

The disc is flecked with the prominent convex black ostiolate apices of the perithecia (PLATE 5, FIG. 2) which are large and protuberant, giving the stroma a papillate aspect. The number of perithecia per stroma varies from 3 in the smallest fruit bodies to 30 in the largest. The average-sized stromal disc usually carries about 15 to 20 perithecia.

The eight-spored asci are oblong, somewhat swollen at the middle and with a blue staining (in iodine) plug in the apical pore (TEXT FIG. 3). Measurement of 50 asci gave an average size of $145.3 \times 15 \mu$ with a mode of $137 \times 13 \mu$. This is considerably larger than the measurements given in the original description (80–100 μ). Examination of type material (N. A. Fungi 2354) shows the asci immature with the spores hyaline or only slightly colored. They, however, measure well over 100 μ . The paraphyses are hyaline, septate, slender, tapering slightly below.

The mature ascospores (PLATE 5, FIG. 4) are rather long elliptical, black with a lighter linear groove on one side (TEXT FIG. 5). They are surrounded by a hyaline gelatinous coat. Measurements of 100 ascospores averaged $20.2 \times 9.16 \mu$ with a mode of about $18 \times 8.7 \mu$, which is again decidedly larger than that given by Ellis and Everhart ($12\text{--}15 \times 6\text{--}7 \mu$). The immature spores from the type material however measure about 15 to $16.2 \times 6\text{--}8.4 \mu$. The structure of the stroma and perithecia is shown in the somewhat diagrammatic sketch (TEXT FIG. 4) of a longitudinal section through the disc and tip of the stalk.

CULTURE EXPERIMENTS

The dried rabbit dung bearing the *Poronia* was taken to Cornell University. Some weeks later, some of the dung balls were placed in a moist chamber for a day or so preparatory to photographing. It was observed that the black ascospores were ejected some centimeters and adhered to the lid of the moist chamber. This suggested the possibility of obtaining the fungus in pure culture.

The junior author undertook the culture work. Preliminary attempts to germinate the spores scraped from the lid of the moist chamber failed though trials were made in water, dung decoction and on potato agar. A few attempts were made to stimulate

grown in pure culture are in general of about the same form and size as those occurring in nature. They vary in size to about the same extent as those on the dung balls from Bermuda except that the stalks are relatively long.

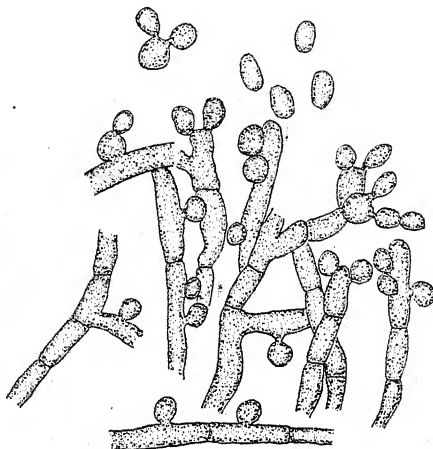


FIG. 5. Conidia developed in pure culture on the mycelial hyphae covering the young stromata. $\times 1000$.

The stromata are at first blunt or pointed slender columns covered with a tender white mycelial web bearing minute globose conidia borne somewhat like microconidia along the sides of the septate hyphae (TEXT FIG. 5). No attempts were made to germinate these conidia but they probably function in propagating the fungus.

Specimens of this fungus are deposited in the Plant Pathology herbarium at Cornell University, No. 15060 (Fungi of Bermuda No. 375), duplicates of which are also to be found in the herbarium of the New York Botanical Gardens and in the mycological collections of the Bureau of Plant Industry, U. S. Department of Agriculture.

The photograph of the fungus was prepared for us by Mr. Fisher of Cornell University and the kodak views of the island by Mr. Thomas Godet. The drawings are by the junior author.

EXPLANATION OF PLATE 5

Fig. 1. *Poronia Oedipus*, natural size.

Fig. 2. *Poronia leporina*, $2\times$ natural size. The two dung balls with stromata at the left are shown in top view, the one to the right shows the stromata in side view.

Fig. 3. *Poronia leporina* as it develops in pure culture on sterilized rabbit dung on moist cotton in test tubes. On the left, mature stromata, cotton and dung removed from test tube. On the right, immature stromata still in the test tube.

Fig. 4. Spores of *Poronia leporina*, $\times 310$.

THE RUSTS OF SOUTH AMERICA BASED ON THE HOLWAY COLLECTIONS—II¹

H. S. JACKSON

SPECIES ON SALICACEAE

50. MELAMPSORA HUMBOLDTIANA Speg. Anal. Mus. Nac. Buenos Aires 23: 28. 1912.

Melampsora americana Arth. Bull. Torrey Club 47: 465. 1920.

Melampsora americana Jorstad, Rep. Sci. Res. Nouv. Exped. Nov. Zembyla 18: 11. 1923.

Salix Humboldtiana Willd. Arequipa, Peru, July 9, 1920, 767.

The collection, which includes uredinia only, is on the type host for the species. This is the only *Melampsora* described from South America on *Salix* and has been reported previously only from Argentina. Arthur (N. Am. Fl. 7: 668. 1924) has included with this the North American species *M. americana* Arth. The latter has been cultured in North America to *Abies* by Fraser (Mycologia 4: 187. 1912). It is quite possible that the European *Melampsora Abieti-cupreorum* Tubeuf. 1902, (*Caeoma Abietis pectinatae* Rees. 1869) is the same. We are retaining the South American name for the purposes of this list, however, because no suitable material of the European form is available for study.

51. MELAMPSORA MEDUSAE Thüm. Bull. Torrey Club 6: 216. 1878.

Uredo Medusae Arth. Résult. Sci. Congr. Bot. Vienne 338. 1906.

Populus sp. Cochabamba, Bolivia, Feb. 27, 1920, 341;
La Paz, Bolivia, Mch. 31, 1920, 488.

These collections answer well to the above species. The urediniospores are relatively large, 28–35 μ in length, with smooth

¹ Contribution from the Botanical Department of the Purdue University Agricultural Experiment Station.

The first article of this series will be found in Mycologia 18: 139–162. 1926.

spots. It seems best to assign the collections to the North American species for the present.

SPECIES ON BETULACEAE

52. MELAMPSORIDIUM ALNI (Thüm.) Dietel, in E. & P. Nat. Pfl.
1¹: 551. 1900.

Melampsora Alni Thüm. Bull. Soc. Mosc. 53: 226. 1878.

Alnus Mirbelii Spach. Cuenca, Prov. del Azuay,
Ecuador, Sept. 15, 1920, 986.

Only one other collection is known from South America, made by G. Lagerheim at Quito, Ecuador, in 1889. The species is recorded from California and Guatemala in North America and is also known in Japan and Eastern Asia.

SPECIES ON MORACEAE

53. CEROTELIUM FICI (Cast.) Arth. Bull. Torrey Club 44: 509.
1917.

Uredo Fici Cast. Desmaz. Pl. Crypt. (Fasc. 34) 1662.
1848.

Uredo Fici guarapiensis Speg. Anal. Soc. Ci. Argent. 17:
120. 1884.

Uredo ficicola Speg. Anal. Soc. Ci. Argent. 17: 120. 1884.

Physopella Fici Arth. Résult. Sci. Congr. Bot. Vienne 338.
1906.

Ficus angustifolia Miq. Guayaquil, Ecuador, July 31,
1920, 802.

Ficus ibapohy Mart. São João, São Paulo, Brazil, July
2, 1922, 1992.

A common species in tropical regions throughout the world. It has been previously reported from South America from Trinidad, Argentina, Brazil and Ecuador.

54. UREDO CONSANGUINEA Syd. Osterr. bot. Zeitschr. 52: 184.
1902.

Dorstenia multiformis Miq. Petropolis, Rio de Janeiro,
Brazil, Nov. 2, 1921, 1267.

This collection is made near the same locality and on the same host as the type collection. We have not seen the type but the description fits our material except that the paraphyses are not strongly developed. This species is evidently closely related to *Uredo rubescens* Arth. The latter has been reported from Trinidad on *Dorstenia Contrajerva* L.

SPECIES ON URTICACEAE

55. PUCCINIA URTICAE Barclay, Sci. Mem. Med. Off. India 2: 38. 1887.

Urtica ballotaefolia Wedd. Quito, Ecuador, Aug. 13, 1920, 880.

The type of this species has not been available for study but this collection answers the description very well and we think it best to assign it to this species for the present. It is evidently a micro-form. The teliospores in our specimen measure 14–18 by 40–55 μ , with apex thickened 3–7 μ .

SPECIES ON LORANTHACEAE

56. *Aecidium Phrygilanthi* Jackson & Holway, n. sp.

O. Pycnia not seen.

I. Aecia amphigenous, chiefly hypophyllous, in irregular groups, 0.5–0.8 cm. across, on discolored spots along veins, small, 0.5–0.8 mm. across; peridium firm, cylindric, erose at margin, yellowish; peridial cells irregularly rhomboid, considerably overlapping, 20–30 by 30–40 μ , outer wall smooth, 2.5–3.5 μ thick; inner wall finely verrucose, 2–3 μ thick; aeciospores globoid or ellipsoid, 24–28 by 25–35 μ , wall colorless, 1.5–2 μ thick, finely verrucose.

Phrygilanthus eugenioides (H.B.K.) Eichl. Sorata, Bolivia, April 17, 1920, 538 (type).

57. *Aecidium Struthanthi* Jackson & Holway, n. sp.

I. Aecia amphigenous, chiefly hypophyllous, in groups on more or less circular hypertrophied areas, 3–5 mm. across; peridium cylindrical, erose, golden-yellow, rather firm; peridial cells oblong or narrowly rhomboidal in side view, 14–18 by 22–38 μ , outer wall thick, 4–7 μ , strongly transversely striate; inner wall 1.5–2.5 μ , finely and closely verrucose-rugose; aeciospores irregularly

globoid or ellipsoid, 18–20 by 26–34 μ , wall slightly tinted golden-yellow, 2.5–3 μ thick, very finely and closely verrucose, appearing smooth.

Struthanthus marginatus (Desv.) Blume. Therezopolis, Rio de Janeiro, Brazil, Sept. 30, 1921, 1177.

This species does not agree exactly with any described on Loranthaceae and it seems best to give it a distinctive name until it is possible to make a careful comparative study of all the species of *Aecidium* and *Uromyces* which have been described on this family. There are evidently a considerable number of species involved. The above species is quite different from the aecia of *Uromyces Urbanianus* which is reported from North America on the same host genus.

58. *Uromyces Loranthi* Jackson & Holway, n. sp.

II. Uredinia amphigenous, gregarious and somewhat confluent on definite, somewhat thickened spots, 1.5–3 mm. across, often arranged in a concentric manner, tardily naked, cinnamon brown, ruptured epidermis conspicuous and persistent; urediniospores ellipsoid or obovoid, 26–30 by 30–38 μ ; wall 1.5–2 μ , light cinnamon brown, finely and moderately echinulate, pores 4, equatorial.

III. Telia not seen; teliospores in the central uredinium obovoid, 19–23 by 26–42 μ , wall 1.5–2 μ , thickened at apex, 6–8 μ , finely and closely verrucose, pedicel colorless, short.

Loranthus sp. Sabará, Minas Geraes, Brazil, Dec. 2, 1921, 1358.

Three other species of *Uromyces* have been described on Loranthaceae having this type of life history;—*U. euphlebius* Sydow from Mexico, *U. Socius* from Guatemala, and *U. ornatipes* from Lower California. The species described above differs from all in the character of the markings of the teliospores which show no tendency to be arranged in lines.

While making this study the writer had occasion to examine the type of *Uromyces Phtirusae* Mayor on *Phtirusa purifolia* (H.B.K.) Eichler, and found that the supposed teliospores which were described are really the urediniospores and that the teliospores, which are present, were not described by Mayor. The urediniospores are strongly striately marked and in general correctly described (as teliospores) except that there are 4 distinct

equatorial pores. The teliospores are irregularly ellipsoid, 18–26 by 26–40 μ , wall light chestnut brown, evenly 2–2.5 μ thick, very closely and minutely verrucose with the markings occasionally arranged in lines. The pedicel is colorless and short.

SPECIES ON SANTALACEAE

59. *UROMYCES QUINCHAMALII* Nèger, Anal. Univ. Chile 93: 777. 1896.

Quinchamalium bracteosum Phil. Viña del Mar, Chile, Sept. 14, 1919, 22.

Quinchamalium gracile Brongn. La Paz, Bolivia, March 26, 1920, 462.

Quinchamalium majus Brongn. Termas de Chillan, Chile, Dec. 31, 1919, 258.

Quinchamalium thesioides Phil. Papudo, Chile, Sept. 18, 1919, 41.

A characteristic species, evidently a eu-form in which the aecia are systemic in the host plant. Urediniospores have been described, but are rare in our material. This species has previously been reported only on *Q. majus* from Chile, Patagonia and Argentina.

SPECIES OF POLYGONACEAE

60. *PUCCINIA POLYGONI-AMPHIBII* Pers. Syn. Fung. 227. 1801.

Uredo Polygoni Schum. Pl. Saell. 2: 233. 1803.

Puccinia Polygoni Alb. & Schw. Consp. Fung. 127. 1805.

Dicaeoma Polygoni-amphibii Arth. Proc. Ind. Acad. Sci. 1898: 184. 1899.

Polygonum punctatum Ell. Therezopolis, Rio de Janeiro, Brazil, Sept. 28, 1921, 1156.

Polygonum sp. Cochabamba, Bolivia, Feb. 25, 1920, 318; Cascadura, Rio de Janeiro, Brazil, Aug. 24, 1921, 1069.

61. *UROMYCES POLYGONI* (Pers.) Fuckel, Jahr. Nass. Ver. Nat. 23–24: 64. 1870.

Puccinia Polygoni Pers. Neues Mag. Bot. 1: 119. 1794.

Nigredo Polygoni Arth. Résult. Sci. Congr. Bot. Vienne
334. 1906.

Polygonum aviculare L. Papudo, Chile, Sept. 17, 1919,
28.

The collection consists of uredinia only, but appears to be the same as the common North American rust on this host.

62. *UROMYCES CRASSIPES* Diet. & Neg. Engler Bot. Jahrb. 27: 2.
1899.

Rumex cuneifolius Campd. Arequipa, Peru, July 9,
1920, 766.

Rumex conglomeratus Murr. Constitucion, Chile, Oct.
23, 1919, 136; Linares, Chile, Dec. 23, 1919, 247.

Rumex sp. Zapallar, Chile, Sept. 22, 1919, 59; Val-
divia, Chile, Nov. 14, 1920, 176; Puerto Varas,
Lago Llanquihue, Chile, Nov. 26, 1919, 185.

This is evidently a common species in Chile and Peru, though not reported elsewhere. The collections consist of uredinia only, with the exception of No. 247, which bears a few telia.

SPECIES ON AMARANTHACEAE

63. *Aecidium Alternantherae* Jackson & Holway, n. sp.

O. Pycnia epiphyllous, few in small groups, globoid or depressed globoid, 80–110 μ wide by 75–85 μ high, ostiolar filaments absent.

I. Aecia chiefly epiphyllous in small groups on slightly discolored spots, small, 0.2–0.4 mm. across; peridium membranous, thin, inconspicuous, colorless, erose at margin; peridial cells seen in face view irregularly polyhedral, 22–30 by 30–45 μ , wall thin, colorless, without evident markings; aeciospores globoid or ellipsoid, 23–28 by 28–40 μ , wall thick, 2–2.5 μ , very finely verrucose.

Alternanthera Moquinii (Webb) Dusén. Bello Horizonte, Minas Geraes, Brazil, Nov. 24, 1921, 1333;
Nov. 26, 1921, 1338 (type); Dec. 1, 1921, 1356.

This is a very distinct species suggesting an *Endophyllum* in its characters. A few uredinia are present on specimens 1338 and 1356. These are similar to those referred in the following pages

to *Puccinia Mogiphanis* (Juel) Arth. This aecidium, however, is quite different from that found on some of the other collections which are referred to that species and which is described on page 58.

64. *Aecidium pratae* Jackson & Holway, n. sp.

O. Pycnia not seen.

I. Aecia hypophyllous, gregarious, few, in small groups 1.5–4 mm. across, small, 0.2–0.5 mm. across; peridium short, cylindric, yellowish; peridial cells rectangular, convex on inner side, abutted, 16–20 by 26–32 μ in side view, outer wall 6–8 μ thick, transversely striate, very finely verrucose on surface; inner wall 2.5–3 μ , coarsely tuberculate verrucose; aeciospores angularly globoid or broadly ellipsoid, 16–20 by 18–23 μ , wall thin, 1 μ , very minutely verrucose, appearing smooth.

On undetermined Amaranthaceae, Prata, São Paulo, Brazil, Apr. 9, 1922, 1716 (type).

This *Aecidium* is quite different from the aecia accompanying the uredinia referred to *Puccinia Mogiphanis* and differs from *A. bonariense* Speg. in the size of the spores.

65. PUCCINIA MOGIPHANIS (Juel) Arth. Bot. Gaz. 45:469. 1918.

Uredo Mogiphanis Juel, Bih. Kongl. Svenska Vet. Akad. Handl. 23, III, 10: 24. 1897.

Achyranthes sp. Quito, Ecuador, Aug. 18, 1920, I, II, 913; Silvestre, Rio de Janeiro, Brazil, Dec. 25, 1921, 1423.

Alternanthera mexicana (Schlecht.) Hieron. Cochabamba, Bolivia, March 14, 1920, I, 407.

Alternanthera Moquinii (Webb) Dusén. Pocos da Caldos, São Paulo, Brazil, April 8, 1922, II, 1711.

Alternanthera paniculata H.B.K. Huigra, Chimborazo, Ecuador, Aug. 3, 1920, II, 829; Sorata, Bolivia, April 19, 1920, II, 553.

Alternanthera puberula Dietr. Nictheroy, Rio de Janeiro, Brazil, Aug. 22, 1921, 1061.

Alternanthera ramosissima (Mart.) Chod., São Paulo, Brazil, Jan. 22, 1922, II, 1487; São Paulo, Brazil, Jan. 22, 1922, II, 1490.

The specimens listed above, with the exception of Nos. 407 and 913, bear uredinia only. The spores are slightly smaller than the type, but agree with other South American collections referred to this species. There appear to be 4-6 scattered pores while *Uredo maculans* Pat. & Gaill., which is apparently closely allied, appears to have only 3-4 pores distributed approximately at the equator.

The following specimens in the Arthur herbarium, previously reported as *Puccinia striolata* (Speg.) Arth. (*P. macropoda* Speg.), are not that species but agree with the Holway collections listed above: on *Alternanthera ramosissima* (Mart.) Chod. from Brazil, J. N. Rose, 20733; *Alternanthera pubiflora* (Moq.) Kuntze from Ecuador, J. N. Rose, 22346; *Achyranthes* sp. from Ecuador, A. Pachano, 111.

This species has not been reported for North America. Collections with somewhat similar urediniospores have been referred to *Uredo maculans* Pat. & Gaill. It is not, however, entirely clear as to what this name refers. It is possible that there are several species included under these two names. The true situation can only be determined when more specimens with telia are available for comparative study.

Two of the collections bear aecia, Nos. 407 and 913. The first is not accompanied by uredinia, but the other is associated with uredinia on the same leaves. The two aecia are the same. A description follows.

I. Aecia amphigenous, chiefly hypophyllous, in groups 0.5-0.8 cm. across, surrounding a group of pycnia; peridium short, cylindric, erose at margin, yellowish; peridial cells irregularly rhomboid, 16-26 by 26-32 μ in side view, convex on inner side, outer wall 6-8 μ thick, transversely striate, minutely rugose on surface, the markings arranged in an irregularly concentric manner; inner wall 2-3 μ thick, tuberculate verrucose; aeciospores globoid or broadly ellipsoid, 26-32 by 32-42 μ , wall thin, 1-1.5 μ , finely verrucose.

66. PUCCINIA STRIOLATA (Speg.) Arth. Mem. Torrey Club 17: 142. 1918.

Uredo striolata Speg. Anal. Soc. Cient. Argent. 9: 174. 1880.

Puccinia macropoda Speg. Anal. Soc. Cient. Argent. 10: 8.
1880.

Dicaeoma striolatum Arth. N. Am. Fl. 7: 387. 1920.

Iresine Celosia L. Cochabamba, Bolivia, March 4,
1920, II, III, 366.

This specimen bears uredinia typical of the type of *Uredo striolata* Speg. A few teliospores are also present. It should be noted, however, that there is another species with striate urediniospores common in S. America, which is described in the following pages as *Uromyces clarus*.

67. *Uredo Alternantherae* Jackson & Holway, n. sp.

II. Uredinia hypophyllous and cauliculous, scattered, round or nearly so, 0.5–1.5 mm. across, tardily naked, dark cinnamon brown, ruptured epidermis conspicuous; urediniospores ellipsoid, 26–30 by 32–34 μ , wall 2.5–3 μ , cinnamon brown, moderately echinulate-verrucose, pores 4–6, scattered.

Alternanthera paniculata H.B.K. Cuenca, Ecuador,
Sept. 10, 1920, 977 (type).

This species differs from *Puccinia Mogiphanis* and *Uredo maculata* in the relatively remote placing of the urediniospore markings.

68. *UROMYCES BONARIENSIS* Speg. Anal. Soc. Cient. Argent. 10:
133. 1880.

Uredo argentina Speg. Anal. Soc. Cient. Argent. 9: 172.
1880. (Not *Uromyces argentinus* Speg. 1880.)

Gomphrena perennis L. Huigra, Provincia Chimborazo,
Ecuador, Aug. 4, 1920, 844.

This species appears to be quite distinct. We have been able to compare our specimen with the type of *Uredo argentina* Speg. and find substantial agreement. The urediniospore wall is verrucose-echinulate with the markings very closely placed. There are 4–6 scattered pores. The spores somewhat resemble those of *P. Mogiphanis* and *Uredo maculata*, but are consistently smaller.

69. *UROMYCES CELOSIAE* Diet. & Holw. Bot. Gaz. 31: 326. 1901.
Puccinia obesispora Arth. Bull. Torrey Club 47: 473.
1920.
? *Uredo nitidula* Arth. Bull. Torrey Club 47: 473. 1920.
Nigredo (?) *Celosiae* Arth. N. Am. Fl. 7: 246. 1912.
Dicaeoma (?) *obesisporum* Arth. N. Am. Fl. 7: 387. 1920.
-

Iresine sp. Therezopolis, Rio de Janeiro, Brazil, Oct.
6, 1921, 1197.

Iresine erianthos Poir. Petropolis, Rio de Janeiro, Brazil,
Nov. 3, 1921, 1275.

Amaranthaceous vine. Cantareira, São Paulo, Brazil,
May 30, 1922, 1915.

The three specimens listed above are assigned to this *Uromyces* with some doubt. Only uredinia are present in our material and the three specimens show some variation in size, shape and wall thickness. All of these variations can, however, be duplicated in the type specimen. The characteristic feature of the urediniospores is the sparse prominent markings and the equatorial pores.

The type of *P. obesispora* has been carefully studied and the only teliospores which could be found were scattered singly on the surface of the leaf. It seems quite certain that they are stray spores from another species, probably one of the *Euphorbia* rusts. The urediniospores agree with the *Uromyces*.

70. *Uromyces clarus* Jackson & Holway, n. sp.

II. Uredinia hypophyllous, scattered or gregarious in more or less concentric groups, 0.4–0.8 cm. across, round, or oval, tardily naked, light golden brown, ruptured epidermis conspicuous and persistent; urediniospores obovoid, 18–24 by 24–28 μ , wall 1.5–2 μ thick, prominently obliquely striate, the lines 2–3 μ apart, pores obscure.

III. Telia not seen, teliospores in the uredinium obovoid or ellipsoid, 20–24 by 26–32 μ ; wall colorless, 1.5–2 μ thick, apex thickened, 4–7 μ ; pedicel colorless, two to three times length of spore.

Iresine Celosia L. El Chaco, Sur Yungas, Bolivia, May
25, 1920, 649 (type); Cantareira, São Paulo, Brazil,
May 30, 1922, 1914.

This species is very characteristic but has been confused with *Puccinia striolata* (Speg.) Arth. In the latter the urediniospore markings are closer and not so prominent and the spore wall is darker colored. The teliospores somewhat resemble those of *Uromyces Iresines* Lag. but differ somewhat in shape and the thickening at the apex is broad, not merely a slight abrupt thickening over the germ pore as in that species.

71. *UROMYCES IRESINES* Lagerheim; Sydow, Monog. Ured. 2: 277. 1910.

Pucciniola Iresines Arth. N. Am. Fl. 7: 444. 1921.

Iresine Celosia L. Quito, Ecuador, Aug. 14, 1920, 891.

Iresine sp. Quito, Ecuador, Aug. 21, 1920, 936; Quito, Ecuador, Aug. 28, 1920, 949.

A characteristic opsis form known in South America only from Ecuador and Colombia and in North America from Guatemala and St. Thomas.

SPECIES ON NYCTAGINACEAE

72. *Aecidium Muehlenbeckiae* Jackson & Holway, n. sp.

O. Pycnia amphigenous, depressed globose, 60–80 μ high by 110–145 μ broad, ostiolar filaments prominent and extruded.

I. Aecia hypophyllous, gregarious and numerous, in groups 0.8–1.0 cm. across, on discolored somewhat thickened spots, small, round, 0.2–0.5 mm. across; peridium yellowish, erose at margin; peridial cells nearly rectangular in side view, 15–18 by 26–32 μ , outer wall smooth, 4–7 μ thick, transversely striate; inner wall 1.5–2 μ , very finely and closely verrucose, convex; aeciospores globose or ellipsoid, 16–18 by 20–22 μ , wall thin, 1 μ or less, finely verrucose.

Muehlenbeckia chilensis Meissn. Temuco, Chile, December 5, 1919, 199.

73. *PUCCINIA COLIGNONIAE* Speg. Anal. Mus. Nac. Buenos Aires 6: 226. 1899.

Colignonia glomerata boliviana Hemsl. Sorata, Bolivia. Apr. 14, 1920, 523.

Colignonia rufopilosa Kuntze. San Felipe, Sur Yungas, Bolivia, May 19, 1920, 612.

A typical micro-form otherwise known only from the type locality in Argentina. We have not seen the type, but the description fits our material so well that there can be little doubt as to the correctness of the determination. The first collection listed is on a variety of the type host.

74. *Uredo Muehlenbeckiae* Jackson & Holway, n. sp.

II. Uredinia amphigenous, chiefly hypophyllous, scattered, round, 0.5–1.0 mm. across, somewhat tardily naked, cinnamon or chocolate brown, ruptured epidermis conspicuous; urediniospores regularly obovate, 20–24 by 26–32 μ , wall thin, 1 μ , light cinnamon brown, very minutely and moderately echinulate, the pores prominent, 4 super-equatorial.

Muehlenbeckia chilensis Meissn. La Paz, Bolivia, March 23, 1920, 446 (type).

Muehlenbeckia tamnifolia Meissn. Quito, Ecuador, Aug. 14, 1920, 888.

A very distinct species characterized by the very fine echinulations, placed at moderate distance apart, and by the four slightly super-equatorial pores.

SPECIES ON CARYOPHYLLACEAE

75. PUCCINIA ARENARIAE (Schum.) Wint. in Rab. Krypt. Fl. 1¹: 167. 1881.

Uredo Arenariae Schum. Enum. Pl. Saell. 2: 232. 1803.

Micropuccinia Arenariae Arth. & Jackson; Arth. Bull. Torrey Club 48: 40. 1921.

Cerastium arvense L. Concepción, Chile, Oct. 27, 1919, 141.

Cerastium vulgatum L. Puerto Varas, Lago Llanquihue, Chile, Nov. 21, 1919, 182.

Cerastium sp. Peulla, Lago Todas los Santos, Chile, Nov. 30, 1919, 195.

A short cycled form found in all parts of the world in temperate or alpine regions. Known otherwise from South America only in Argentina.

76. *Puccinia arenariicola* (P. Henn.) n. comb.*Uredo arenariicola* P. Henn. Hedwigia 35: 253. 1896.*Puccinia modica* Holway, Jour. Myc. 10: 164. 1904.*Dicaeoma* (?) *modicum* Arth. N. Am. Fl. 7: 388. 1920.

Arenaria lanuginosa (Michx.) Rohrb. Campos de
Jordão, São Paulo, Brazil, Apr. 21, 1922, II, III, 1748.

The type of this long cycled species was collected in Argentina on the same host (as *A. diffusa* Ell.). A comparison with *P. modica* Holw. shows that they are the same. The specimens show both uredinia and telia.

SPECIES ON RANUNCULACEAE

77. *Aecidium clematidis* DC. Fl. Fr. 2: 243. 1805.*Clematis dioica* L. Quito, Ecuador, Aug. 13, 1920, 870.

This *Aecidium* is listed here for completeness. It belongs with *Puccinia clematidis* (DC.) Lag., having uredinia and telia on various grasses (see Arthur, J. C., the Grass Rusts of South America, Proc. Am. Phil. Soc. 44: 160. 1925).

78. *Coleosporium clematidis* Barclay, Jour. Asiat. Soc. Bengal 59, II: 89. 1890.*Clematis* sp. Alto da Serra, São Paulo, Brazil, June 14, 1922, 1965.

This is the first record of a *Coleosporium* on *Clematis* from the western hemisphere. We are assigning it to the above species for the present. The collection consists of uredinia only.

SPECIES ON BERBERIDACEAE

79. *Aecidium aridum* Diet. & Neg., Engl. Bot. Jahrb. 17: 13. 1899.*Berberis Darwinii* Hook. f. Peulla, Lago Todas, Sur Santos, Chile, Nov. 30, 1919. 192.

This collection while on an unrecorded host for the species has been compared with the type and agrees in all essential characters.

80. *Aecidium Léveilléanum* P. Magn. Ber. Deutsch. Bot. Ges. 10: 323. 1892.

- Uredo Berberidis* Lév. Ann. Sci. Nat. III. 5: 268. 1846.
? *Uredo Aecidiiformis* Speg. Bol. Acad. Nac. Ci. Córdoba
11: 183. 1888.
-

- Berberis actinacantha* Mart. Baños de Cauquenes,
Chile, Jan. 18, 1920, 299a.
Berberis Blaurina Bellb. Itatiaya, São Paulo, Brazil,
May 18, 1922, 1867.
Berberis buxifolia Lam. Peulla, Lago Todas, Los Santos,
Chile, Nov. 29, 1919, 190a; Recinto, Chile, Jan. 9,
1920, 281; Terman de Chillan, Dec. 28, 1918, 253a.
Berberis congestiflora Gay. Temuco, Chile, Nov. 5,
1919, 166a; Dec. 5, 1919, 198a.
Berberis polymorpha Phil. Termas de Chillan, Chile,
Jan. 3, 1920, 269.

We are following Dietel & Neger (Engl. Bot. Jahrb. 27: 6-13. 1899) and Sydow (Monog. Ured. 4: 247-248. 1923) in keeping this *Aecidium* as a separate species. It is worthy of note, however, that five of the eight collections here reported were associated with *Puccinia Mayeri-Alberti* P. Magn. Dietel and Neger, however, have found other species of *Aecidium* associated and there seems to be some doubt as to the connection of this *Aecidium* with *P. Mayeri-Alberti*. A collection of the *Puccinia* is in the Arthur herbarium associated with *A. tubiforme* Diet. & Neger. This was collected by R. Thaxter on *Berberis buxifolia* at Punte Arenas, Magellanes, Chile. The question can only be finally settled by infection experiments.

81. PUCCINIA MAYERI-ALBERTI P. Magn. Ber. Deutsch. Bot.
Ges. 10: 320. 1892.
-

- Berberis actinacantha* Mart. Baños de Cauquenes, Chile,
Jan. 18, 1920, 299.
Berberis Blaurina Bellb. Campos do Jordão, São Paulo,
Brazil, Apr. 21, 1922, 1749.
Berberis buxifolia Lam. Peulla, Lago Todas, Los Santos,
Chile, Nov. 29, 1919, 190; Termas de Chillan, Chile,
Dec. 28, 1919, 253.

Berberis chilensis Gill. Panamavida, Chile, Dec. 10, 1919, 215.

Berberis congestiflora Gay. Temuco, Chile, Nov. 5, 1919, 166; Dec. 5, 1919, 198.

Berberis ruscifolia Lam. La Falada, Argentina, Aug. 17, 1922, 2033.

We have included in this species the forms having narrow spores and slightly thickened apices. With six of the collections, aecia were present on all or part of the leaves. These have been segregated and are reported under the name *Aecidium Léveilleanus* P. Magn. It is possible that the two are genetically connected. There is some doubt however, and we prefer to keep the two forms separate for the purposes of this list.

82. *Puccinia Rameliana* Jackson & Holway, n. sp.

III. Telia hypophyllous, scattered, round, 0.2–0.4 mm., early naked, pulverulent, blackish, ruptured epidermis not evident; teliospores broadly ellipsoid, 22–26 by 28–38 μ , rounded above and below, scarcely constricted; wall chestnut brown 2.5–3.5 μ thick, apex not or slightly thickened above to 4–5 μ , prominently and rather coarsely tuberculate; pedicel firm, colorless, equalling the spore or shorter.

Berberis sp. Cuenca, Ecuador, Sept. 10, 1920, 981 (type).

While no urediniospores were seen, this species does not have the aspect of a micro-form. The name is in honor of H. Ramel, manager of the Casa Pieterse, who aided the collectors in various ways during their stay in Cuenca.

It is possible that this species may belong to *Uropyxis*. We have hesitated to assign it to that genus as we have been unable to detect any pores in the teliospore. It is, however, much like *P. Stolpiana* (P. Magn.) Diet. & Neg. (Engl. Jahrb. 27: 13. 1899) which has been assigned to *Uropyxis*. Our collection differs in the character of the markings of the surface of the spore and in the presence of persistent pedicels.

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FUNGI OF SANTO DOMINGO—I

RAFAEL A. TORO

(WITH PLATE 6)

Our knowledge of the fungi of Santo Domingo is comparatively meager. Berkeley (5) appears to have been the first to make a study of the fungous flora of this Island. His work is based on a collection made by A. Sallé and eighteen of the sixty-seven species studied were described as new. Later Berkeley (6), in connection with his studies of Australian fungi, reëxamined his Santo Domingan species, *Peziza domingensis*, and made it the type of the new genus *Phillipsia*. With the exception of a few short papers by González Fragoso and Ciferri (13), (14), (15), (16), (17), Ciferri and González Fragoso (9), dealing with the fungi, and a note by the writer (28) on the myxomycètes of that Island, all references to Santo Domingan fungi are scattered within the literature of other regions.

The fungus *Aecidium Cordiae* P. Henn. was described from a specimen collected in Santo Domingo, by Ehrenberg, and published by Bresadola, Hennings and Magnus (7) in connection with their studies on Porto Rico fungi. Lévêille (18) and Lloyd (19) refer to the fungi collected by Poiteau in Hispaniola. It is doubtful, however, whether these fungi belong to Santo Domingo proper since there is no record of Poiteau having ever collected outside of Haiti. Feé (11) describes a new species of *Sphaeria* from this Island, *S. divaricata*, which was renamed by Saccardo (21) *Xylaria divaricata* (Feé) Sacc. Saccardo (l.c.) also re-examined most of Berkeley's Santo Domingan species of *Hypoxylon* and changed them to *Xylaria*. Reference is also made by Saccardo (22) to a rust described by deCandolle from this Island. In his studies of the Uredinales, Arthur (1), (2), (3), (4) includes Santo Domingo in the geographical distribution of many of the species. Burt (8) refers to species of *Stereum* collected by Taylor and by Stevenson; Olive and Whetzel (20) extend the range of *Endophyllum Stachytarpetae* to this Island, while the writer (29)

reports the results of his studies in connection with *Chaetosphaeria Bromeliae* Frag. & Ciferri.

The present paper is based on a collection made by Kern and Toro during March, 1926. Over 400 specimens were collected in the regions around Macoris, San Cristóbal, Bonao, La Vega, Santiago, Puerto Plata, Santo Domingo and La Romana. The study of this material reveals facts of sufficient importance to warrant this publication. Most of the species reported in this paper were unknown to the Island while few are described as new. Species reported for the first time in this paper are marked with asterisk (*) while new combinations or species are shown in **bold faced type**. The rusts are not considered in this work since they will be the subject of a forthcoming paper by the senior collector.

I desire to express my thanks to Mr. Carlos E. Chardón, Commissioner of Agriculture and Labor of Porto Rico, who made possible the collecting and studying of this material; Dr. N. L. Britton of The New York Botanical Garden for valuable assistance rendered; to Mr. Percy Wilson of the same institution for identification of the hosts of the fungi studied; to Dr. F. J. Seaver, under whose direction the work was done, for valuable suggestions and criticism and for reading and correction of the proof. Finally an expression of appreciation is due to Mr. Rafael A. Espaillet, Secretary of Agriculture of Santo Domingo; Dr. R. Ciferri, Director of the Experiment Station, and Mr. Santiago Michelena, a resident of Santo Domingo, whose courtesy and help made our enterprise more successful.

PHYCOMYCETES

PERONOSPORALES

ALBUGINACEAE

- *1. ALBUGO CANDIDA (Pers.) Kuntze, Rev. Gen. Pl. 2: 658.
1891.

Aecidium candidum Pers. in Gmel. Syst. Nat. 2: 1473.
1791.

On *Brassica Urbaniana* O. E. Schulze, Santiago, March 22,
No. 258.

- *2. ALBUGO IPOMOEAE-PANDURANEAE (Schw.) Swingle, Jour. Myc. 7: 112. 1892.

Aecidium Ipomoeae-panduraneae Schw. Schr. Nat. Ges. Leipzig 1: 169. 1822.

On *Ipomoea cathartica* Poir., San Cristóbal, March 13, No. 171.

- *3. ALBUGO PLATENSIS (Speg.) Swingle, Jour. Myc. 7: 113. 1892.

Cystopus platensis Speg. Rev. Argent. Hist. Nat. 1: 32. 1891.

On *Boerhaavea erecta* L., Bajabonico, March 25, No. 140.

PERONOSPORACEAE

- *4. PSEUDOPERONOSPORA CUBENSIS (Berk. & Curt.) Rostow, Flora 92: 422. 1903.

Peronospora cubensis Berk. & Curt. Jour. Linn. Soc. 10: 363. 1868.

On *Pepo moschata* (Duch.) Britton, Bajabonico, March 25, No. 293.

- *5. PSEUDOPERONOSPORA PORTORICENSIS (Lamkey) Seaver & Chardón in Sci. Surv. Porto Rico 8: 13. 1926.

Peronospora portoricensis Lamkey; Stevens, Mycologia 12: 52. 1920.

On *Melia Azedarach* L., Puerto Plata, March 24, No. 286.

- *6. RHYSOTHECA HALSTEDII (Farl.) Wilson, Bull. Torrey Bot. Club 34: 403. 1907.

Peronospora Halstedii Farl. Proc. Am. Acad. Sci. 18: 72. 1883.

On *Bidens cynapiifolia* H.B.K., San Cristóbal, March 14, No. 191; Puerto Plata, March 24, No. 283.

No record showing that this fungus occurs in the West Indies has been seen by the writer. The host is also a new one for the fungus. Our specimen shows great variations especially with respect to the swellings of the branches. It is also unlike the other specimens on other hosts, in that the epispore is smooth instead of wrinkled.

ASCOMYCETES

PLECTASCALES

ASPERGILLACEAE

- *7. CERATOCARPIA WRIGHTII (Berk. & Curt.) Toro; Seaver & Chardón in Sci. Surv. Porto Rico 8: 17. 1916.
Perisporium Wrightii Berk. & Curt. Grevillea 4: 157. 1875.
Perisporiopsis Wrightii Stevens, Trans. Illinois Acad. Sci. 10: 170. 1917.
On *Opuntia* sp., Santiago, March 22, No. 261.

HYSTERIALES

HYPODERMATACEAE

- *8. LOPHODERMIIUM PINASTRI (Schröd.) Chev. Flora Paris 1: 430. 1826.
Hysterium Pinastri Schröd. Jour. Bot. 2: 69. 1799.
On *Pinus occidentalis* Sw., Bonao, March 16, No. 230.

HEMISPHERIALES

MICROTHYRIACEAE

- *9. ASTERINA DIPLOCARPA Cooke, Grevillea 10: 129. 1882.
On *Sida carpinifolia* L. f., La Vega, March 17, No. 221; San Cristobal, March 13, No. 166.
- *10. ASTERINA CHRYSOPHYLLI P. Henn. Hedwigia 48: 12. 1908.
On *Chrysophyllum oliviforme* L., Consuelo, March 10, No. 142; Santiago, March 22, No. 262.
- *11. ASTERINA CORIACELLA Speg. Bol. Acad. Nac. Ci. Córdoba 11: 560. 1889.
On *Cestrum diurnum* L., La Vega, March 20, No. 199.
- *12. ASTERINA JURUANA (P. Henn.) Theiss. Abh. Zool.-Bot. Ges. Wien 7: 84. 1913.
Seynesia juruana P. Henn. Hedwigia 43: 376. 1904.
On *Casearia guianensis* Urban, Bonao, March 16, No. 237.

- *13. *ASTERINA MEGALOSPORA* Berk. & Curt. Jour. Linn. Soc. 10: 373. 1868.

On *Passiflora rubra* L., San Cristóbal, March 14, No. 184.

- *14. *ASTERINA MELASTOMATIS* Lév. Ann. Sci. Nat. III 3: 59. 1845.

On *Heterotrychum umbellatum* (Mill.) Urban, Bonaó, March 16, No. 248

The host is a new one for this species.

- *15. *ASTERINA SOLANICOLA* Berk. & Curt. Jour. Linn. Soc. 10: 374. 1868.

On *Turnera ulmifolia* L., Santo Domingo, March 27, No. 301.

- *16. *CAUDELLA PSIDII* Ryan, Mycologia 16: 179. 1924.

On *Psidium Guajava* L., San Cristóbal, March 13, No. 168; Bonaó, March 16, No. 232. (PLATE 6, FIG. 8 AND 11).

HEMISPHERIACEAE

- *17. *MICROPELTIS ALBO-OSTIOLATA* P. Henn. Hedwigia 47: 268. 1908.

On *Casearia guianensis* Urban, Santiago, March 21, No. 259.

Although our specimen has smaller perithecia and asci than those described by P. Hennings (l.c.) for this species, the spores and other characters agree well with the description.

18. *Myriangiella arcuata* sp. nov.

Thyriothecia mostly epiphyllous, roundish, brown, pseudo-parenchymatous, 425–550 μ in diameter, easily breaking into unequal fragments, upper portion with a thick band of angular cells surrounding a thinner layer and thus simulating an ostium 80–100 μ in diameter; asci spherical, thick-walled, sessile, 40–55 μ in diameter, 8-spored; spores inordinate, slightly curved or straight, unequally 9–11-septate, not constricted, 45–54 \times 8–9 μ , ends obtuse, hyaline; paraphyses wanting. (PLATE 6, FIG. 1 AND 2).

On *Casearia aculeata* Jacq., San Cristóbal, March 13, No. 176 (Type). *Scolecopeltis micropeltiformis* Toro is also associated with this species.

In their treatment of the Hemisphaeriaceae, Theissen and Sydow (27) recognize the genus *Phragmothyriella* v. Höhn. and

separate it from *Microthyriella* v. Höhn. because it has many-celled spores. They also treat *Myriangiella* Zimm. as a doubtful genus of the Saccardiaceae. The genus *Myriangiella* was established by Zimmermann (33) with the single species, *M. orbicularis* Zimm. Later v. Höhnel (30) found that *M. orbicularis* Zimm. had all the appearances of a *Micropeltis* or some related genus and renamed the species *Micropeltis orbicularis* (Zimm.) v. Höhn. Afterwards v. Höhnel (31) in his revision of the genus *Micropeltis* excluded *M. orbicularis* (Zimm.) v. Höhn. and put it in the new genus *Phragmothyriella*. According to v. Höhnel, the fungus described by Zimmermann is a new genus and species. There is no reason why he should choose another name since *Myriangiella* Zimm. is synonymous and antedates *Phragmothyriella* v. Höhnel. *Phragmothyriella Molleriana* (Sacc.) v. Höhn. will then become *Myriangiella Molleriana* (Sacc.) comb. nov.

- *19. *SCOLECOPELTIS MICROPELTIFORMIS* Toro, Mycologia 17: 137. 1925.

On *Casearia aculeata* Jacq., San Cristóbal, March 13, No. 176.
The host is a new one for this species.

PERISPORIALES

PERISPORIACEAE

- *20. *APPENDICULELLA COMPOSITARUM* (Earle) Toro, Mycologia 17: 144. 1925.

Meliola Compositarum Earle, Bull. N. Y. Bot. Gard. 3: 306. 1905.

On *Osmia odorata* (L.) Sch. Bip., Bonao, March 16, No. 233; Santo Domingo, March 27, No. 297.

On *Mikania* sp., Bonao, March 16, No. 249; La Vega, March 19, No. 217.

- *21. *Appendiculella tonkinensis* (Karst. & Roum.) comb. nov.

Meliola tonkinensis Karst. & Roum. Rev. Myc. 12: 77. 1892.

Meliola reticulata Karst. & Roum. Rev. Myc. 12: 78. 1892.

According to Gaillard (12), *M. reticulata* is identical with *M. tonkinensis*. The differences between both species lie in the fact

that the latter was described from undeveloped material. Our specimen agrees with the description given by Gaillard, except that the perithecial appendages in the Santo Domingan specimen are more prominent and numerous. This may be due, however, to a difference in maturity and more extensive studies of the species are needed before we can determine with certainty whether we are dealing with one or two species.

On *Cecropia peltata* L., Bonao, March 16, No. 241.

- *22. DIMERIELLA CORDIAE (P. Henn.) Theiss. Beih. Bot. Centr. 29²: 67. 1912.

Dimerosporium Cordiae P. Henn. Hedwigia 48: 4. 1908.

On *Varronia angustifolia* West., Santiago, March 21, No. 279.

On *Varronia globosa* Jacq., Santiago, March 21, No. 278.

23. *Dimerina dominicana* sp. nov.

Fungus epiphyllous, forming irregular, scattered, black-brown spots, 2-7 mm. in diameter; mycelium light-brown, thickly interwoven, septate, 4-6 μ thick; perithecia superficial, globose, astomous, black, 117-135 μ in diameter; asci fasciculate, numerous, clavate-cylindrical, short-stipitate, 8-spored, 54-58 \times 14-24 μ , thick-walled; spores inordinatè, 1-septate, not constricted, 16-22 \times 4.5-6 μ , hyaline; paraphyses longer than the asci, filiform, numerous. (PLATE 6, FIG. 3 AND 5.)

Differs from *Dimerina ovoidea* (Speg.) Theiss. in the shape and size of the perithecium and in having smaller spores.

On *Wallenia laurifolia* Sw., San Cristóbal, March 13, No. 178 (Type), No. 175.

- *24. DIMERINA EUTRICA (Sacc. & Berl.) Theiss. Beih. Bot. Centr. 29²: 65. 1912.

Dimerosporium eutrichum Sacc. & Berl. Rev. Myc. 7: 156. 1885.

On *Meliola* sp. on *Hyptis capitata* Poit., Bonao, March 16, No. 245.

On *Hyptis lantanifolia* Poit., Santo Domingo, March 27, No. 299.

- *25. IRENE HYPTIDICOLA (Stevens) Toro, Mycologia 17: 139. 1925.

Meliola hyptidicola Stevens, Illinois Biol. Monog. 2: 484. 1917.

On *Hyptis verticillata* Jacq., Consuelo, March 10, No. 146; La Vega, March 17, No. 219.

On *Hyptis capitata* Jacq., Bonao, March 16, No. 238.

*26. IRENE LONGIPODA (Gaill.) Toro, Mycologia 17: 141. 1925.

Meliola longipoda Gaill. Bull. Soc. Myc. Fr. 8: 178. 1892.

On *Citharexylon fruticosum* L., La Vega, March 19, No. 211; Santiago, March 21, No. 281.

*27. IRENE MELASTOMACEARUM (Speg.) Toro, Mycologia 17: 141. 1925.

Meliola Melastomacearum Speg. Bol. Acad. Nac. Ci. Córdoba 11: 494. 1889.

(On *Clidemia hirta* (L.) D. Don, Bonao, March 16, No. 227.

*28. IRENE OBESA (Speg.) Theiss. & Sydow, Ann. Myc. 15: 461. 1917.

Meliola obesa Speg. Anal. Soc. Ci. Argent. 18: 264. 1884.

On *Zanthoxylon fagara* L., Santiago, March 21, No. 280.

*29. IRENE PLEBEJA (Speg.) Theiss. & Sydow, Ann. Myc. 15: 461. 1917.

Meliola plebeja Speg. Bol. Acad. Nac. Ci. Córdoba 11: 502. 1889.

On *Solanum rugosum* Dunal, Bonao, March 16, No. 236.

*30. **Irene Solani** (Stevens) comb. nov.

Meliola Solani Stevens, Illinois Biol. Monog. 2: 483. 1917.

Although Stevens (25) in his description says that setae are present a careful examination of his type (Porto Rico Fungi No. 5750) shows that these setae are only mycelial threads spreading from the base of the perithecium and sometimes they bear capitate hyphopodia. A comparative study of this and the preceding species may show them to be the same. The dimensions of our specimen overlap those of these two species.

On *Solanum torvum* Sw., Bonao, March 16, No. 244.

- *31. *MELIOLA AMBIGUA* Pat. & Gaill. Bull. Soc. Myc. Fr. 4: 104. 1888.

Meliola Paullinae Stevens, Illinois Biol. Monog. 2: 513. 1917.

Meliola Serjaniae Stevens, Illinois Biol. Monog. 2: 512. 1917.

A comparison of the Porto Rican specimens collected by Stevens (No. 7268, 425, and 1149) with our Santo Domingan specimen shows that the setal characters are very variable. In some cases the setae are mostly acute and straight while the same specimen, in another slide, may show curved, obtuse setae. This is specially true in the specimen from Santo Domingo where these differences are very evident in the same microscopic mount. Since the three species show identical characters and occur on members of the same family, they should be considered the same.

Meliola Thouinia Earle differs from these only on the predominance of the opposite hyphopodia. However, the hyphopodia are both alternate and opposite in all cases, which may indicate the inclusion also of this species as a synonym.

On *Allophyllus cominia* (L.) Sw., San Cristóbal, March 14, No. 193.

On *Lantana trifolia* L., Bajabonico, March 23, No. 264; Santiago, March 22, No. 263.

On *Serjania polyphylla* Radlk., Santiago, March 22, No. 267.

On *Casearia guianensis* Urban, San Cristóbal, March 13, No. 169.

32. *Meliola aristata* sp. nov.

Fungus epiphyllous, forming black, slightly raised, orbicular spots 1-3 mm. in diameter; mycelium branched, closely interwoven, septate, cells $36-40 \times 8-10 \mu$, brown; capitate hyphopodia alternate, sometimes unilateral, 1 per cell, $25-33 \mu$ long; head cell ovate, sometimes lobed, $18-22 \mu$ in diameter; basal cell $7-11 \mu$ long, $7-9 \mu$ wide; mucronate hyphopodia few, opposite, bottle-shaped, lighter in color, about 22μ long; mycelial setae abundant, black, tips acute and lighter in color, septate, mostly straight, $275-300 \mu$ long, $12-14 \mu$ wide; perithecia glabrous, astomous, $110-150 \mu$ in diameter; asci evanescent, 2-spored; spores 4-septate, light brown, constricted at septum, tips obtuse, cells subequal, $50-54 \times 20-22 \mu$. (PLATE 6, FIG. 7, 12, 13 AND 14).

This is the first species of *Meliola* reported on the Passifloraceae. Apparently our species differs from *M. eriophora* Speg. in having smaller perithecia and larger spores.

Beelian formula 3111-53.2.1.

On *Passiflora* sp., San Cristóbal, March 14, No. 181 (*Type*).

*33. MELIOLA BIDENTATA Cooke, Grevillea 11: 37. 1882.

On *Tabebuia* sp., Santo Domingo, March 25, No. 289.

*34. MELIOLA CLAVULATA Wint. Hedwigia 25: 98. 1886.

On *Ipomoea batatas* Lam., Bonao, March 16, No. 242.

On *Ipomoea cathartica* Poir., Bonao, March 16, No. 246; San Cristóbal, March 14, No. 195; La Vega, March 19, No. 212.

*35. MELIOLA CRENATO-FURCATA Sydow, Ann. Myc. 14: 77. 1916.

On *Stygmaphyllon lingulatum* (Poir.) Small, Santiago, March 22, No. 254. (PLATE 6, FIG. 10.)

*36. MELIOLA DESMODII Karst. & Roum. Rev. Myc. 10: 77. 1890.

On *Meibomia axilaris* (Sw.) Kuntze, Bonao, March 16, No. 247.

On *Meibomia cana* (Gmel.) Blake, San Cristóbal, March 14, No. 196; La Vega, March 19, No. 215.

On *Bradburgia virginiana* Kuntze, Santiago, March 22, No. 200.

*37. MELIOLA DIEFFENBACHIAE Stevens, Illinois Biol. Monog. 2: 530. 1917.

On *Dieffenbachiae seguine* (Jacq.) Schott, Bonao, March 16, No. 234.

*38. MELIOLA EVANIDA Gaill. Ec. Sup. Pharm. Paris 1: 102. 1892.

On *Tetragastris balsamifera* (Sw.) Kuntze, Bonao, March 16, No. 229.

The specimen is referred to this species with some hesitancy. Although the setae characters are identical with what Gaillard describes for his species, the perithecia and spores of our specimen differ from his. (PLATE 6, FIG. 4.)

39. MELIOLA FURCATA Lév. Ann. Sci. Nat. III. 5: 266. 1846.
On *Coccothrinax argentea* (Lodd.) Sargent, Santiago, March 21,
No. 276.
- *40. MELIOLA GUIDNARDII Gaill. Bull. Soc. Myc. Fr. 8: 176.
1892.
On *Turpinia paniculata* Vent., Bonao, March 16, No. 243.
- *41. MELIOLA MANGIFERAE Earle, Bull. N. Y. Bot. Gard. 3: 307.
1905.
On *Mangifera indica* L., San Cristóbal, March 13, No. 165.
- *42. MELIOLA MERILLII Sydow, Philippine Jour. Sci. 8: 479.
1913.
On *Cissus sicyoides* L., La Vega, March 17, No. 220.
- *43. MELIOLA MICONIAE Stevens, Illinois Biol. Monog. 2: 498.
1917.
On *Miconia laevigata* DC., La Vega, March 19, No. 208.
- *44. MELIOLA MOLLERIANA Wint. Hedwigia 25: 98. 1886.
On *Sida urens* L., Haina, March 11, No. 151; San Cristóbal,
March 13, No. 157; La Vega, March 19, No. 209.
- *45. MELIOLA PANICI Earle, Muhlenbergia 1: 12. 1901.
On *Olyra latifolia* L., Santo Domingo, March 27, No. 303.
- *46. MELIOLA PIPERIS Earle, Muhlenbergia 1: 12. 1901.
Meliola Gaillardiana Stevens, Illinois Biol. Monog. 2: 529.
1917.
There are four species of *Meliola* with forked setae reported on
Piper. Their differences are so slight that if a comparative
study of the type materials is made, it may be found that they
are all identical. If that is the case, then they should be placed
under *M. Patouillardii* Gaill., the older described species. *M.*
Piperis Earle (Heller 4359b) shows both forked and toothed
setae.
On *Piper aduncum* L., Bonao, March 16, No. 235.
- *47. MELIOLA POPOWIAE Doidge, Trans. Roy. Soc. South Africa
8: 142. 1920.
On *Anona reticulata* L., San Cristóbal, March 13, No. 177.

- *48. MELIOLA PRAETERVISA Gaill. Ec. Sup. Pharm. Paris 1: 78. 1892.

On *Coccolobis grandifolia* Jacq., Santo Domingo, March 25, No. 291.

49. MELIOLA PSIDII Fries, Linnaea 5: 549. 1830.

On *Psidium Guajava* L., San Cristóbal, March 13, No. 167.

Reported under *M. amphitricha* Fries by González-Fragoso and Ciferri (13).

50. MELIOLA PSYCHOTRIAE Earle, Bull. N. Y. Bot. Gard. 3: 308. 1905.

On *Randia Mitis* L., San Cristóbal, March 12, No. 155.

On *Borreria laevis* Griseb., San Cristóbal, March 13, No. 159; March 14, No. 197; La Vega, March 19, No. 216; Santo Domingo, March 27, No. 298.

The fungus has been also reported from Santo Domingo on leaves of *Exostema caribaeum* (Jacq.) R. & Sch. by Stevens (25) (Taylor No. 483).

- *51. MELIOLA SAPINDACEARUM Speg. Rev. Arg. Hist. Nat. Buenos Aires 1: 407. 1891.

Meliola crucifera Starb. Arkiv. for Bot. 57^r: 7. 1905.

Meliola Hessii Stevens, Illinois Biol. Monog. 2: 527. 1916.

According to Spegazzini (24) *M. crucifera* and *M. Hessii* are synonyms of *M. Sapindacearum*. The writer has compared our specimen with the figures shown by Stevens (26) and Starback (l.c.) and found that it agrees with both.

On *Melicocca bijuga* L., San Cristóbal, March 13, No. 161.

- *52. MELIOLA STUHLMANNIANA P. Henn. Engl. Bot. Jahrb. 34: 45. 1904.

On *Byrsonima crassifolia* H.B.K., Santo Domingo, March 25, No. 292.

53. MELIOLA TABERNAEMONTANAE Speg. Anal. Mus. Buenos Aires 23: 45. 1912.

On *Rauwolfia tetraphylla* L., San Cristóbal, March 13, No. 162.

On *Tabernaemontana citrifolia* Jacq., Santiago, March 21, No. 282.

- *54. MELIOLA TENUISSIMA Stevens, Illinois Biol. Monog. 2: 492. 1916.

On *Gouania polygama* (Jacq.) Urban, San Cristóbal, March 13, No. 163; Bajabonico, March 23, No. 287.

- *55. MELIOLA TORTUOSA Winter; Gaillard in Ec. Sup. Pharm. 1: 67. 1892.

On *Piper peltatum* L., Bonao, March 16, No. 239.

- *56. MELIOLA TRIUMFETTAE Stevens, Illinois Biol. Monog. 2: 499. 1916.

On *Triumfetta semitriloba* Jacq., San Cristóbal, March 13, No. 170.

- *57. MELIOLA WOODIANA Sacc. & Sydow, Hedwigia 38: 132. 1899.

Our specimen has slightly larger perithecia and more angular capitate hyphopodia than those figured by Doidge (10). A more careful study of the fungus may reveal it to be a new species.

On *Guaiacum officinale* L., Santiago, March 22, No. 257.

- *58. PARODIELLA PERISPORIOIDES (Berk. & Curt.) Speg. Anal. Soc. Ci. Argent. 2: 178. 1880.

Dothidea perisporioides Berk. & Curt. Grevillea 4: 103. 1876.

On *Dolicholus reticulatus* Millsp., Santiago, March 22, No. 265.

- *59. PSEUDOPERISPORIUM ERIGERONICOLUM (Stevens) Toro, Sci. Surv. Porto Rico 8: 41. 1926.

Dimeriella erigeronicola Stevens, Trans. Illinois Acad. Sci. 10: 166. 1917.

On *Leptilon bonariense* (L.) Small, La Vega, March 19, No. 218. The host is a new one for the species.

60. TOROA DIMEROSPORIOIDES (Speg.) Sydow, Toro in Jour. Dept. Agr. Porto Rico 10: 19. 1926.

Asteridium dimerosporioides Speg. Anal. Soc. Ci. Argent. 26: 19. 1888.

This fungus has been described as a new Santo Domingan species under *Chaetosphaeria Bromeliae* González-Fragoso and Ciferri (14).

On *Bromelia Pinguin* L., San Cristóbal, March 14, No. 194;
La Vega, March 19, No. 207.

CAPNODIACEAE

61. *Chaetothyrium variabilis* sp. nov.

Fungus epiphyllous, widely spreading; mycelium light-brown, forming a weft of cylindrical, closely septate hyphae, 5-7 μ wide; perithecia few, globular, ostiolate, raised or closely appressed to the mycelium and then widely spreading, 90-130 μ in diameter, when globular and raised, bearing setae, when spreading, without setae, light-brown to dark in color; setae 1-7 in each perithecium, black throughout, 75-112 \times 7-5 μ , straight, tips acute; asci clavate-ellipsoid, sessile, 40-45 μ long, 22-24 μ wide, 8-spored; spores inordinate, clavate, 4-5-septate, not constricted at septa, 16-18 \times 5-6 μ , hyaline; paraphyses wanting. (PLATE 6, FIG. 6 AND 9.)

On *Wedelia reticulata* DC., Santiago, March 22, No. 260 (Type).

HYPOCREALES

NECTRIACEAE

*62. *CALONECTRIA ERUBESCENS* (Rob.) Sacc. *Michelia* 1: 309.
1878.

Sphaeria erubescens Rob.; *Desm. Ann. Sci. Nat.* III.
6: 72. 1846.

The species name is used in the sense of Seaver (23). According to Weese (32), what Seaver calls *C. erubescens* is probably *C. tubaroensis* since *C. erubescens* does not occur on remains of *Meliola* and is very distinct from this.

On mycelium of *Meliola* on *Banisteria laurifolia* L., San Cristóbal, March 14, No. 186.

DOTHIDEALES

PHYLLACHORACEAE

*63. *CATACAUMELLA GOUANIAE* Stevens, *Bot. Gaz.* 69: 252.
1920.

On *Gouania polygama* (Jacq.) Urban, San Cristóbal, March 13, No. 164; Bajabonico, March 23, No. 158.

- *64. PHYLLACHORA CANAFISTULAE Stevens & Dalbey, Bot. Gaz. 68: 54. 1919.
On *Cassia grandis* L. f., Santo Domingo, March 25, No. 290.
- *65. PHYLLACHORA ERIOCHLOAE Speg. Anal. Mus. Nac. Buenos Aires 19: 416. 1909.
On *Valota insularis* (L.) Chase, Santiago, March 21, No. 275; Haina, March 30, No. 307.
On *Paspalum conjugatum* Berg., San Cristóbal, March 12, No. 156.
- *66. PHYLLACHORA GALACTIAE Earle; Seaver in Britton, Baha-ma Flora 633. 1920.
On *Galactia striata* (Jacq.) Urban, La Vega, March 19, No. 213; Santiago, March 21, No. 277.
- *67. PHYLLACHORA PERFORANS (Rehm) Sacc. & Sydow in Sacc. Syll. Fung. 16: 619. 1902.
Phyllachora dalbergiicola var. *perforans* Rehm, Hedw. 39: 232. 1900.
On *Elsota virgata* (Sw.) Kuntze, San Cristóbal, March 14, No. 189; Bonao, March 16, No. 240; La Vega, March 19, No. 210; Puerto Plata, March 24, No. 287.
- *68. PHYLLACHORA SERJANICOLA Chardon, Mycologia 13: 293. 1921.
On *Serjania polyphylla* (L.) Radlk., Consuelo, March 10, No. 143.
- *69. PHYLLACHORA SPHAEROSPERMA Wint. Hedwigia 23: 170. 1884.
On *Cenchrus viridis* Spreng., Haina, March 30, No. 309.
- *70. TRABUTIA GUAZUMAE Chardon, Mycologia 13: 291. 1921.
On *Guazuma Guazuma* (L.) Cockerell, La Vega, March 17, No. 222.

SPHAERIALES

SPHAERIACEAE

- *71. ROSELLINIA SUBICULATA (Schw.) Sacc. Syll. Fung. 1: 255. 1882.

Sphaeria subiculata Schw. Schr. Nat. Ges. Leipzig 1: 44. 1882.

On dead wood, San Cristóbal, March 12, No. 321.

PLEOSPORACEAE

- *72. LEPTOSPHAERIA SACCHARI van Breda de Haan, Meded. Proefst. Suik. West-Java 1892: 25.

On *Saccharum officinarum* L., Bajabonico, March 23, No. 250.

- *73. METASPHAERIA ABORTIVA Stevens, Trans. Illinois Acad. Sci. 10: 186. 1917.

On *Varronia corymbosa* Desv., Santo Domingo, March 27, No. 300.

This host is new for the fungus.

- *74. PHYSALOSPORA ANDIRAE Stevens, Trans. Illinois Acad. Sci. 10: 184. 1917.

On *Andira inermis* H.B.K., Las Matas, March 27, No. 306.
This species was also collected by J. A. Stevenson in Samaná, Aug. 2, 1918 (No. 7013).

CUCURBITARIACEAE

- *75. NITSCHKIA CUPULARIS Karst. Myc. Fenn. 2: 81. 1873.

On *Sida glabra* Mill. (stems), Santiago, March 21, No. 255.

The specimen is very poor and therefore it is referred to this species with some hesitancy.

VALSACEAE

- *76. VALSA CHLORINA Pat. Bull. Soc. Myc. Fr. 22: 56. 1906.

On husks of *Cocos nucifera* L., San Cristóbal, March 13, No. 310.

XYLARIACEAE

- *77. DALDINIA CONCENTRICA (Bolt.) Ces. & De-Not. Comm. Critt. Ital. 1: 198. 1863.

Sphaeria concentrica Bolt. Fungi Halifax 3: 180. 1789.
Collected by Taylor at Macoris, Nov. 15, 1909, No. 171.

- *78. KRETZSCHMARIA RUGOSA Earle, Bull. N. Y. Bot. Gard. 3: 311. 1905.
On dead wood, San Cristóbal, March 13, No. 314.
- *79. NUMMULARIA BULLIARDII Tul. Fung. Carp. 2: 43. 1863.
On dead wood, San Cristóbal, March 14, No. 318.
- *80. XYLARIA APICULATA Cooke, Grevillea 8: 66. 1879.
On dead wood, San Cristóbal, March 10, No. 320.
- *81. XYLARIA ARBUSCULA Sacc. Michelia 1: 249. 1878.
On dead wood, San Cristóbal, March 13, No. 316.
- *82. XYLARIA CONSOCIATA Starb. Bih. Sv. Vet.-Akad. Handl. 27(3)^o: 17. 1901.
On dead wood, San Cristóbal, March 13, No. 315.

FUNGI IMPERFECTI

SPHAEROPSIDALES

83. ASCHERSONIA TURBINATA Berk. Ann. Mag. Nat. Hist. II. 9: 199. 1852.
On scale insects on *Jambos Jambos* (L.) Millsp., Santo Domingo, March 27, No. 305.
The type specimen of this species was collected in Santo Domingo by A. Salle (No. 75).
- *84. CONIOTHYRIUM CONCENTRICUM (Desm.) Sacc. Michelia 1: 204. 1884.
Phoma concentrica Desm. Ann. Sci. Nat. II. 13: 189. 1840.
On *Yucca aloefolia* L., Santiago, March 20, No. 202.

HYPHOMYCETALES

- *85. CERCOSPORA ATRICINCTA Heald & Wolf, Mycologia 3: 14. 1911.
On *Crassina elegans* (Jacq.) Kuntze, Bajabonico, March 25, No. 295.
- *86. CERCOSPORA CASEARIAE Stevens, Trans. Illinois Acad. Sci. 10: 212. 1917.
On *Casearia guianensis* Urban, Santiago, March 21, No. 274.

- *87. CERCOSPORA CHAMAECRISTAE Ellis & Kellerm.; Ellis & Ev.
Jour. Myc. 8: 7. 1888.
On *Herpetica alata* Raf., San Cristóbal, March 14, No. 190.
88. CERCOSPORA COFFEICOLA Berk. & Curt.; Ellis & Ev. Jour.
Myc. 4: 5. 1888.
On *Coffea arabica* L., San Cristóbal, March 14, No. 192.
- *89. CERCOSPORA CONSPICUA Earle, Bull. N. Y. Bot. Gard. 3:
312. 1905.
On *Cleome ginandra* L., Puerto Plata, March 24, No. 284.
Known also in Porto Rico (its type locality) on *Cleome spinosa*
Jacq.
- *90. CERCOSPORA HENNINGSII Allesch.; P. Henn. in Engl.
Ostafr. Pflanz. 3: 35. 1895.
On *Manihot Manihot* (L.) Cockerell, La Vega, March 20, No.
201.
- *91. CERCOSPORA MALACHRAE Heald & Wolf, Mycologia 3: 19.
1911.
On *Malachra capitata* L., Bajabonico, March 25, No. 296.
- *92. CERCOSPORA PORTORICENSIS Earle, Muhlenbergia 1: 15.
1901.
On *Piper aduncum* L., La Vega, March 19, No. 205.
- *93. CERCOSPORA RICINELLA Sacc. & Berl. Atti Inst. Ven. VI.
3: 11. 1885.
On *Ricinus Communis* L., Consuelo, March 10, No. 144.
- *94. CLADOSPORIUM CALOTROPIDIS Stevens, Trans. Illinois Acad.
Sci. 10: 207. 1917.
On *Calotropis procera* (Ait.) R. Br., Santo Domingo, March 9,
No. 141.
- *95. CLADOSPORIUM FULVUM Cooke, Grevillea 12: 32. 1883.
On *Solanum torvum* Sw., Haina, March 11, No. 153.
- *96. OIDIUM sp.
On *Phaseolus lathyroides* L., San Cristóbal, March 12, No. 154.
On *Sida carpinifolia* Bello, La Vega, March 17, No. 226.

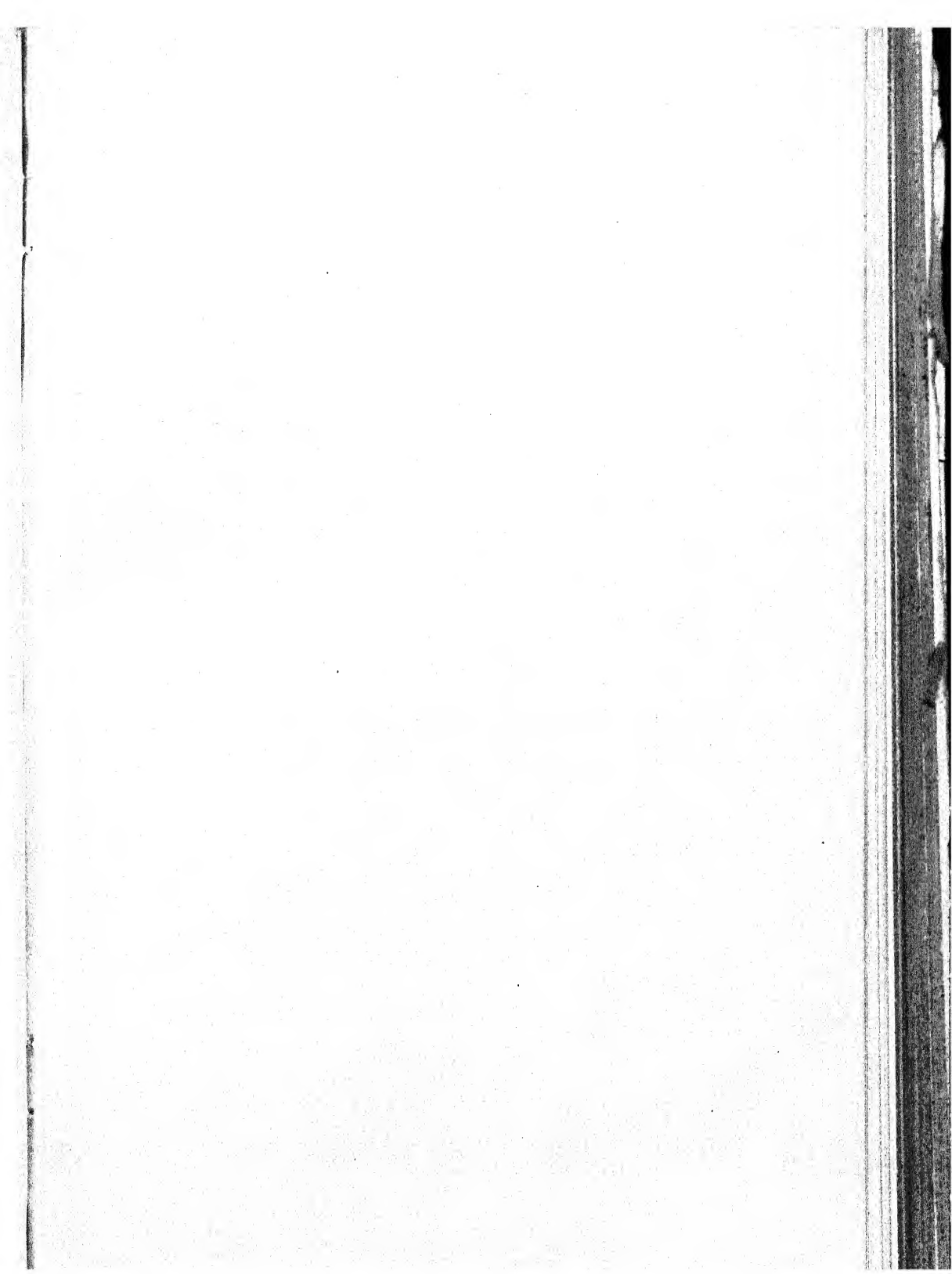
*97. *PACHYTRICHUM GUAZUMAE* Sydow, Ann. Myc. 23: 420. 1925.

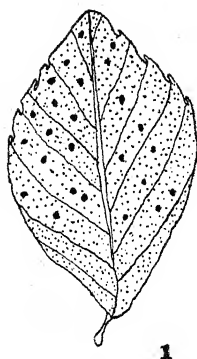
On *Guazuma Guazuma* Cockerell, Santiago, March 20, No. 322.

DEPARTMENT OF PLANT PATHOLOGY,
INSULAR EXPERIMENT STATION,
RÍO PIEDRAS, PORTO RICO

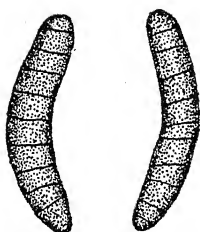
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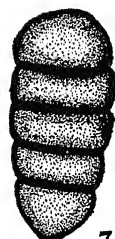
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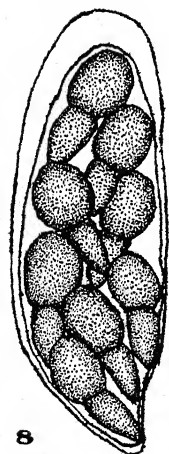
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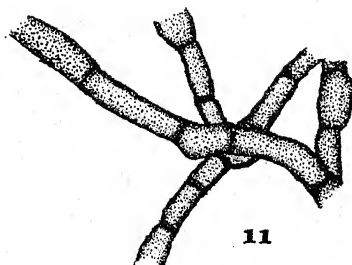
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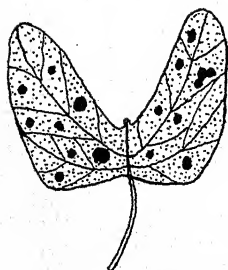
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EXPLANATION OF PLATE 6

- Fig. 1. Diagrammatic sketch of a leaf of *Casearia aculeata* showing the distribution of the thiriothecia of *Miriangiella arcuata*. $\times 1$.
- Fig. 2. Two spores of *Miriangiella arcuata*. $\times 550$.
- Fig. 3. Ascus with 8 spores of *Dimerina dominicana*. $\times 550$.
- Fig. 4. Tip of a seta of *Meliola evanida*. $\times 550$.
- Fig. 5. Two spores of *Dimerina dominicana*. $\times 550$.
- Fig. 6. Ascus with 8 spores of *Chaetothyrium variabilis*. $\times 550$.
- Fig. 7. A spore of *Meliola aristata*. $\times 550$.
- Fig. 8. Ascus with 8 spores of *Caudella Psidii*. $\times 550$.
- Fig. 9. Two spores of *Chaetothyrium variabilis*. $\times 550$.
- Fig. 10. Tip of seta of *Meliola crenato-furcata*. $\times 160$.
- Fig. 11. Mycelium of *Caudella Psidii*. $\times 550$.
- Fig. 12. Seta of *Meliola aristata*. $\times 160$.
- Fig. 13. A leaf of *Passiflora* sp. showing distribution of the colonies of *Meliola aristata*. $\times 1$.
- Fig. 14. A mycelial branch with capitate hyphopodia of *Meliola aristata*. $\times 550$.

A TENTATIVE SCHEME FOR THE TREATMENT OF THE GENERA OF THE PEZIZACEAE

FRED J. SEAVER

For many years past the writer has been engaged in the preparation of a monograph of the operculate cup-fungi of North America and, in fact, the work is so far advanced that it can be published (with illustrations) at any time when the funds seem to be available. Much time has been spent in trying to stabilize the genera on the basis of priority in accordance with the rules of the American code of nomenclature. In view of the fact that an attempt is being made by some mycologists, and others who can scarcely be classified as such, to disregard rules of priority in favor of "common usage," apparently in the hope of appealing to popular sentiment, it seems best at this time to publish a tentative scheme for the genera of the Pezizaceae, as they are being treated by the writer in his forthcoming monograph.

As the most of these genera are in common use, there will probably be no difference of opinion as to their present application. A few changes, however, which appear to be necessary in order to conform to the rule of priority, might at first thought seem radical to one who has made only a casual study of this group. A note will therefore be appended stating the reasons for the use of names where they involve any considerable number of changes in combinations. The reader will then be left to judge for himself as to the merits of the work, and if he will take the trouble to go into the case as thoroughly as the writer has done he will probably arrive at about the same conclusions.

We realize that a perfect classification cannot be worked out with our present incomplete knowledge of the life histories of individual species. No attempt has therefore been made to revolutionize the classification of this group. We are following Boudier's suggestion to divide the Discomycetes into two sections, the operculate and the inoperculate. The Pezizaceae belong to

the former and the family is then divided into a number of tribes based on some of the most conspicuous characters. Classification, however, is here used merely as a means to an end, the end being to present the genera and species of this group in such a manner that they may be readily recognized by the average student of fungi.

PEZIZACEAE

GENERA	TYPE SPECIES
Tribe. SPHAEROSPOREAE	
1. Sphaerospora.....	<i>Peziza trechispora</i> Berk. & Br.
2. Pseudoplectania.....	<i>Peziza nigrella</i> Pers.
3. Sphaerosoma.....	<i>Sphaerosoma fuscescens</i> Klotzsch.
4. Boudiera.....	<i>Boudiera areolata</i> Cooke & Phill.
5. Lamprospora.....	<i>Ascobolus miniatus</i> Crouan.
6. Pithya.....	<i>Peziza pithya</i> Alb. & Schw.
7. Ascodesmis.....	<i>Ascodesmis nigricans</i> Van Tiegh.
8. Cubonia.....	<i>Lastobolus brachyascus</i> March.
Tribe. ASCOBOLAE	
9. Ascobolus.....	<i>Peziza stercoraria</i> Bull.
10. Saccobolus.....	<i>Ascobolus Kerverni</i> Crouan.
Tribe. ALEURIEAE	
11. Aleuria.....	<i>Peziza aurantia</i> Pers.
12. Aleurina.....	<i>Peziza retiderma</i> Cooke.
13. Melastiza.....	<i>Peziza miniata</i> Fuckel.
Tribe. HUMARIEAE	
14. Psilopezia.....	<i>Psilopezia nummularia</i> Berk.
15. Pyronema.....	<i>Pyronema Marianum</i> ? (<i>Peziza Tomphalodes</i> Bull.)
16. Ascophanus.....	<i>Peziza subfusca</i> Crouan.
17. Humarina (in place of Humaria).....	<i>Octospora leucoloma</i> Hedw.
18. Pseudombrophila.....	<i>Pseudombrophila Pedrotii</i> Bres.
19. Streptotheca.....	<i>Streptotheca Boudieri</i> Renney.
20. Ryparobius.....	<i>Ryparobius brunneus</i> Boud.
21. Thecotheus.....	<i>Ascobolus Pelletieri</i> Crouan.
Tribe. LACHNEAE	
22. Sepultaria.....	<i>Peziza Sepulta</i> Fries.
23. ¹ Pseudopithyella gen. nov.	<i>Sarcoscypha minuscula</i> Boud. & Torrend.
24. Perrotia.....	<i>Peziza flammea</i> Alb. & Schw.
25. Lasiobolus.....	<i>Peziza papillata</i> Pers.
26. Patella (in place of Lachnea).....	<i>Peziza ciliata</i> Schaeff.

¹ Characters of the species.

Tribe. OTIDEAE

27. Wynnea.....*Wynnea gigantea* Berk. & Curt.
 28. Phillipsia.....*Peziza domingensis* Berk.
 29. Scodellina (in place of Otidea)....*Peziza leporina* Batsch.

Tribe. SARCOSCYPHEAE

30. Cookeina.....*Peziza Tricholoma* Mont.
 31. Plectania (in place of Sarcoscypha) *Peziza coccinea* Scop.
 32. Bulgaria.....*Burcardia globosa* Schmidel.
 33. Urnula.....*Peziza Craterium* Schw.
 34. Paxina (in place of Acetabula and
 Macropodia).....*Peziza Acetabulum* L.

Tribe. PEZIZEAE

35. Geopyxis.....*Peziza carbonaria* Alb. & Schw. ?
 36. Rhizina.....*Rhizina undulata* Fries.
 37. Discina.....*Discina perlata* Fries.
 38. Peziza.....*Peziza cochleata* L. (*Peziza badia* ?)
 39. Sarcosphaera.....*Peziza macrocalyx* Reiss.

All of the genera suggested above with the exception of five (*Patella*, *Humarina*, *Scodellina*, *Plectania* and *Paxina*) have not only priority in their favor but usage as well, so that these will need no further discussion.

Probably the most radical change proposed is the substitution of *Patella* for the genus *Lachnea* of Saccardo, since the latter name is in use as a valid genus of flowering plants. Even the most ardent advocate of usage would probably not recommend that two plant genera be designated by the same name. Kuntze in 1891 suggested for this genus the name *Scutellinia* and made a number of new combinations but so far as I know this suggestion has never been followed by any student of Discomycetes. Since *Scutellinia* has never come into general usage we recommend the adoption of *Patella*, proposed by Weber in 1780, and recognized by Morgan in 1902.

The new name *Humarina* is also now proposed for the genus *Humaria* of Saccardo, since the latter name is a straight synonym of the genus *Patella*, and since there appears to be no prior name which may be substituted for Saccardo's genus *Humaria*.

The genus *Scodellina* was founded by S. F. Gray in 1821 and based on *Peziza leporina* Batsch. In 1869 Fuckel proposed the genus *Otidea* founded on the same species. On the basis of priority we accept the former name. This is a small genus, however,

and the change will not cause any great confusion. Only two new combinations will be necessary in our scheme.

Also *Plectania* of Fuckel antedates *Sarcoscypha* of Saccardo by twenty years and its adoption is proposed. To carry out this suggestion three new combinations will be necessary.

The name *Acetabula* is rejected by us since the same name is in use for a genus of algae. Kuntze proposed the substitution of *Paxina* in 1891 for this genus and Clements in 1903 proposed *Phleboscypus*. In the present work we accept *Paxina*.

As this is a tentative scheme the writer would welcome suggestions based on actual investigations. Mere objections, however, by those who have not taken the trouble to look into the matter of nomenclature or who have not made a critical study of the Discomycetes in particular can be of little use.

THE NEW YORK BOTANICAL GARDEN

NOTES AND BRIEF ARTICLES

A CORRECTION

In the September-October issue of MYCOLOGIA, 1926, volume 18, No. 5, page 232, was published a description of a new species of *Sclerotinia*. The ending of the species name "ae" is an error. It should read *Sclerotinia Erythronii*. H. H. WHETZEL.

SPONGIPELLIS FISSILIS

On December 7, I was taken by several of the Florida Experiment Station men to Magnesia Springs, fourteen miles east of Gainesville, on a collecting trip; and there, in the moist woods, we found a very handsome specimen of *Spongipellis fissilis*. It grew in the angle between two buttresses of a large living laurel oak and the cluster of overlapping pilei measured about six inches broad and high:

Every part of the hymenophore was pure milk-white; a cross section of the context showed the zones very faintly; and the tubes were large and angular, with no appearance of resin and no unpleasant odor. The following day, I noticed that finger prints on the hymenium of specimens brought in had begun to turn dark, and in four days the entire mass of tubes had become very dark and resinous in appearance, while the zones in the context stood out very plainly, and a disagreeable odor pervaded the room.

A week later, we were collecting at Newnan's Lake, near Gainesville, and found a specimen of this same species growing twenty feet up on the trunk of a large living sweet gum. There was only one pileus in this case, but it was a foot in diameter and two inches thick. Mr. West put several bullet holes through it from his rifle without dislodging even a fragment for closer inspection, but when pushed off with a long pole it came down in several pieces.

This hymenophore had probably developed two or three weeks previously; the surface had become discolored and the tubes

were dark and odorous. It might be interesting to investigate the steps in this oxidation process and determine not only the cause of the dark color, but also of the resinous appearance and odor of decaying protein. In some polypores, the tubes attract insects with sugar when the spores are mature. Is it possible that *Spongipellis fissilis* is in the habit of courting green flies?

W. A. MURRILL.

MYCOPHAGIC NOTES

THE EDIBILITY OF LEOTIA

Leotia is a fungus I never tried to eat before because I never found enough of it to make a meal. On December 16, however, east of Gainesville, Fla., three of us found more than we cared to pick, the hymenophores coming up on a grassy knoll near some pine trees in such large numbers that we could stand in one spot and gather a small paper-bagful. Because of the sand, the yellowish-brown stems often went quite deep into the ground, and not infrequently the dark-green caps rested on the soil.

In preparing this fungus, I washed it well to free it from sand particles; placed the entire hymenophore, stem and all, into a pan with a little salt and very little water; and boiled it under a tight cover for nearly fifteen minutes. It was a satisfaction to watch it cook, because instead of shrinking to one tenth its size, more or less, it actually became larger, owing to its gelatinous nature. One has to guess at the time to take it off, as it does not soften like most mushrooms.

How does it taste? That is a difficult question. It feels somewhat like pickled pig's feet between the teeth and has to be chewed for some time before it is broken up; and it is so slippery that one of the sporophores will often escape down the throat without any chewing whatever. There is also a slight acid taste and no particular flavor to offset it. On the whole, I should not recommend it unless the situation were urgent; but I am glad I had the experience. I ate it in quantity at three consecutive meals without the least unpleasantness, then returned to *Armillaria mellea*, which tasted unusually good by comparison. To make a dish of *Leotia* synthetically, take one part freshly chopped rubber bands, one part dried gum from peach trees, two parts pickled pig's feet, add water, mix well, and stew slowly for twenty minutes. W. A. MURRILL.

AMANITA POISONING

In the early forenoon of Saturday, September 11, 1926, James Marks, a day laborer, aged 55 years, collected, in a thin woodland near London, Ont., three or four quarts of mixed, white mushrooms. They were cleaned and stewed in milk with chopped parsley and onions. The parents with two children, John Marks, aged 12, and Annie, aged 7 years, had dinner about 11 o'clock and ate a portion of the mushroom stew.

In the mid-afternoon, a Polish acquaintance, Stan. Slivinski, aged 45, called at the Marks home. He learned of the mushroom delicacy they had had for dinner; regretted that he had not gone mushroom collecting with Marks and was pleased when he was given a bowl of the stew which he took away to the home of Joseph Shyzmanski. Between 3 and 4 o'clock these two men sat down to enjoy the treat. Shyzmanski sampled two or three spoonfuls, declared they were bitter and that he did not like them and stopped with that. Slivinski said "They are good—I like them," and finished his dish. The former assured me himself that he did not swallow more than a good teaspoonful.

By 5.00 P.M. Mrs. Marks began to feel pain in the region of the stomach and nausea, succeeded by dizziness and a feeling she described "as if she were drunk." Thereupon she dosed herself heavily with castor-oil. Shortly afterwards her husband came into the house feeling "queer." And then Slivinski called to thank them for the mushrooms and finding two of them ill assured them that it couldn't be the fault of the mushrooms seeing that he was feeling fine and tried to cheer them by saying they would all be singing "Alleluia" in the morning.

In the late evening the twelve-year-old boy alarmed the neighbors with the story that his father and mother were dying; by 9.00 o'clock the two children as well as the parents were very ill. Medical aid arrived. Cramps, particularly in the legs, vomiting, diarrhea, and other evidences indicated amanitine poisoning to the physicians and they did the best in the case that medical science knows. The family including a nursing infant were removed to the hospital.

After the lapse of a like number of hours Slivinski became similarly ill and was taken to the hospital. Shyzmanski's turn came

next; he remained in his comfortable home and was nursed by his family.

The hospital records show, of course, the progress of the poisoning in each case and the remedial measures and medicaments employed to meet the varying conditions as they developed. Taken altogether they exhibit variation and repetition of the following effects: cramping pains, more or less violent, often in the limbs; vomiting, sometimes of greenish liquids; diarrhea, greenish liquid stools, passing of blood; fierce thirst; local or general severe soreness of the muscles; very rapid, weak, thready pulsation; bluish or greenish jaundice; alternation of drowsiness and delirium; rigidity of the limbs; brief coma. In the tale of medication employed, when and as needed, were stomach-washing, colon-flushing, morphia, spiritus frumenti, atropin, digitalis, hyoscine-hydrobromide, adrenalin.

Annie Marks, the seven-year-old child, was the first to be relieved by death. In 22 hours from the eating of the mushrooms her eyes were becoming stary, her extremities rigid and her throat unable to swallow. Before the 24th hour had lapsed her consciousness ceased; adrenalin failed to whip up the heart to further action. She was dead.

The father, a man of rugged, muscular frame, was next to go. On Monday morning, in his delirium, he got out of bed and as late as 4.00 in the afternoon he was struggling to rise. At 4.20, in the 41st hour after the fatal meal, he had ceased to breathe.

Slivinski, an able-bodied and younger man than Marks, whose mushrooms were eaten 4 or 5 hours later, survived him by 12 hours, making 2 days and 14 hours from the time he supped the dish. He was delirious and talking wildly when his eyes began to glaze, his limbs stiffened, his face became gray, his pulse stopped.

Shyzmanski, who stated to me that he hardly more than well-tasted the stew, kept his bed at his home for five days. His acute attacks would seem from the accounts I obtained to have been quite severe but yet less violent and less frequent than those already referred to. On the 5th day, he had one or two of these attacks but at 4.00 o'clock in the afternoon his family thought he was past the crisis and were hopeful of his recovery. And yet, in

less than two hours, with his physician at his bedside fighting for his life, his heart failed.

John Marks, the boy, suffered experiences similar to those of the others. At 8.00 A.M. on the 4th day he stiffened out, and with head thrown backwards, and eyes stary, he mumbled deliriously through an attack that lasted about five minutes. Revived by stimulants, he vomited some greenish fluid and from that time began to improve without serious relapse. He left the hospital on the 25th day, still paralyzed in his legs. With the help of crutches he began to use his legs, gradually recovered their tone and now at the end of two and a half months is nearly well.

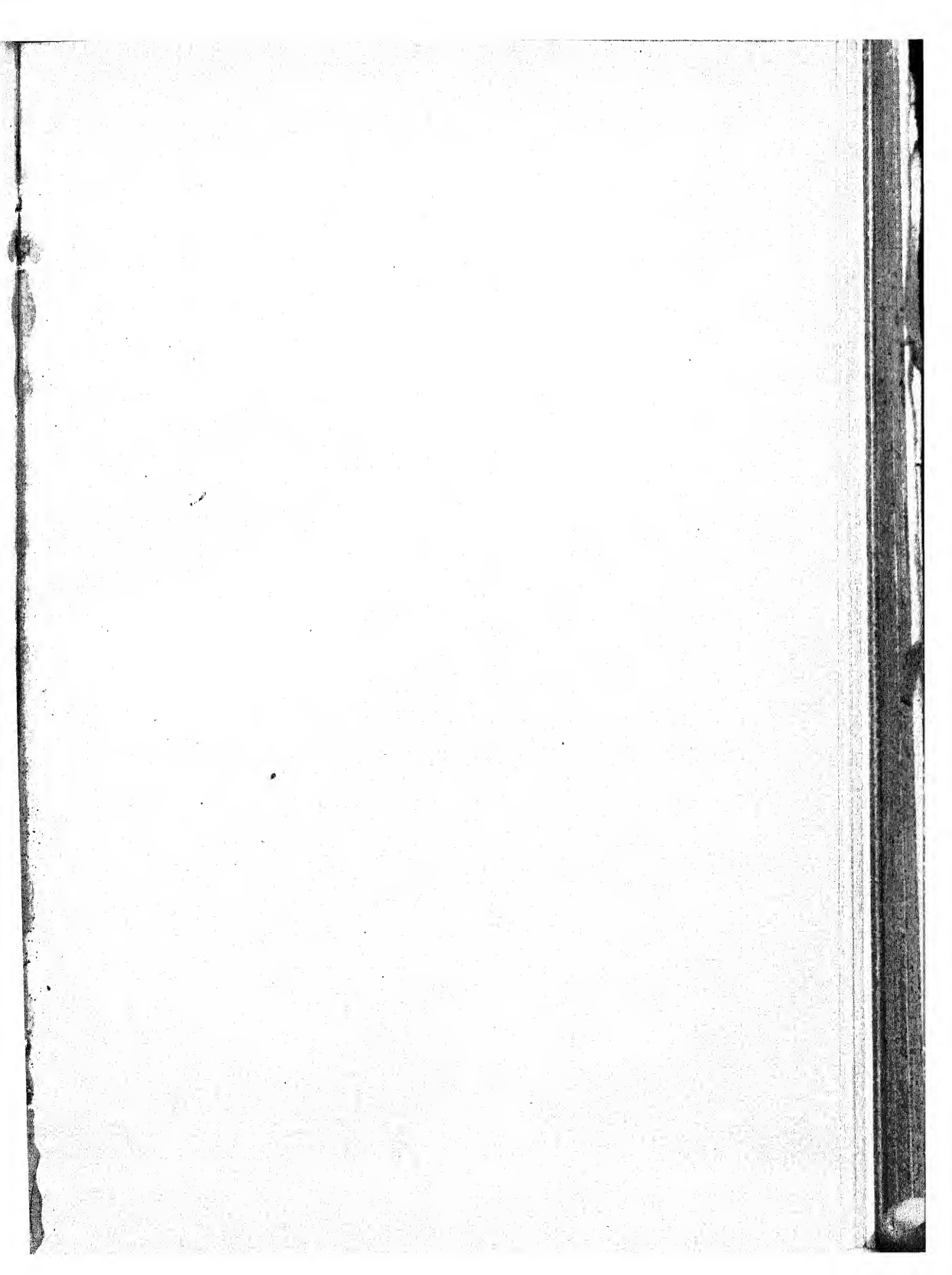
The infant that fed at the breast of the poisoned mother on the first half day showed no toxic effects.

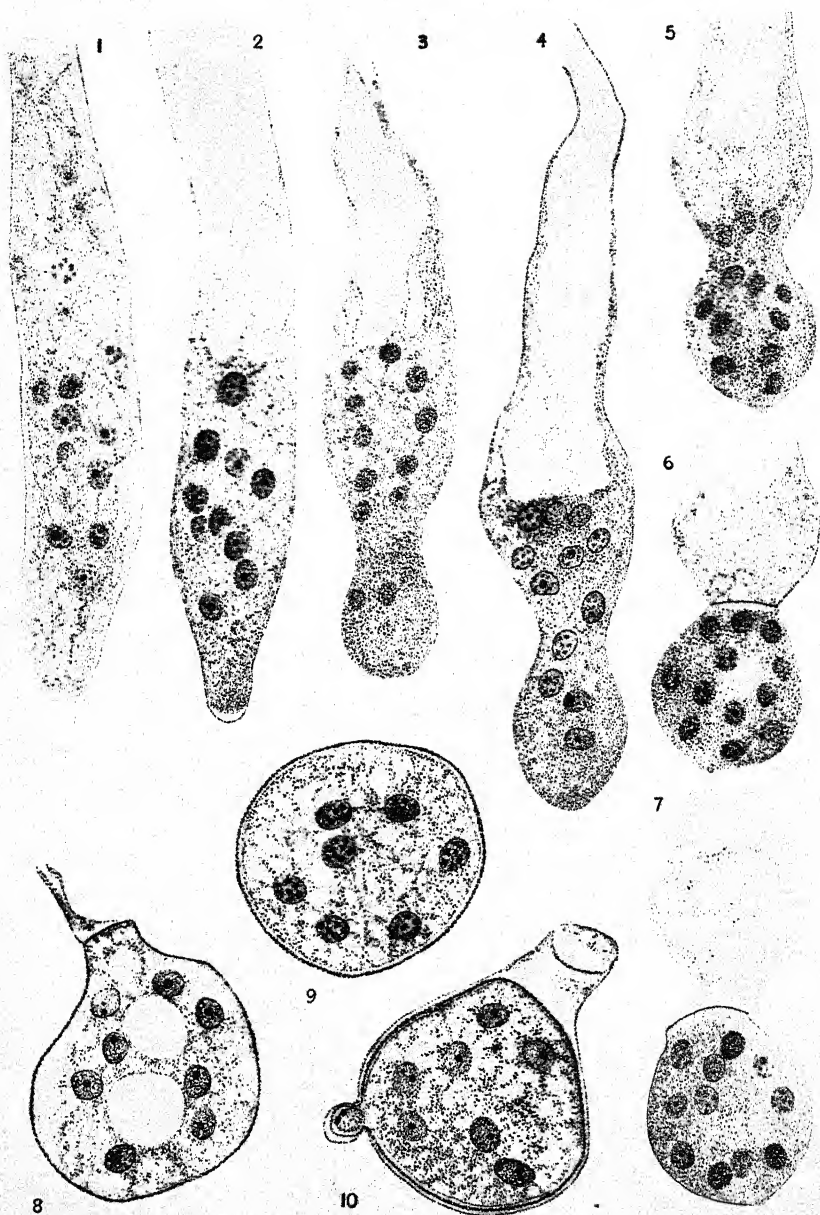
The mother herself who thinks she ate as much of the stew as any of the others suffered terrible pains in all her muscles and passed considerable blood but she seemed to have escaped the intense severity of the onsets endured by those who died. She may have responded more favorably to the medication or the heavy dosing with castor-oil and the early vomiting may have had beneficial effects. She and her son left the hospital the same day. Now in the eleventh week she can still feel the effects of the poisoning in the muscles of her arms and calves.

The title of this report names the genus of the offending fungus; I may fairly go a step further and name the species. Part of the stew had been set aside in the Marks home to be served at a future meal. This or a portion of it was brought to me and by floating it out and gently washing it in large quantities of water the parts became more or less recognizable and, after dissolving the fatty globules out in alcohol and ether, suitable for microscopical examination. There was evidence from spores and tissues of at least five different kinds: infundibulate species of *Clitocybe*, short-celled *Lactars* or *Russulae*, and *Amanitae*. There were two unbroken caps with annulus and most of the stem of *Amanita verna*. There were several stems and portions of caps having appearance and microscopic tissues quite like those of the specimens last named. I judged that approximately 20 to 25 per cent of the collection may have been of *Amanita verna*.

Mr. Marks had evidently been a diligent collector of fleshy

fungi. I was shown a large quantity that he had dried for winter use including many *Boleti*. Of the latter only the tramal part of the caps had been saved. Mrs. Marks informed me that they had found these good eating when they were fresh but they always rejected the stems and the under part—meaning the pore layer. She vows that she will never again eat another mushroom no matter what kind it is or who recommends it. Certainly she came to her resolution at heavy cost. JOHN DEARNESS.





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AN EMPUSA DISEASE OF DROSOPHILA

BESSIE GOLDSTEIN¹

(WITH PLATES 8-10)

Each fall for the last four years there has occurred an epidemic of *Empusa* among the wild fruit-flies at Columbia University. Their abdomens show the swollen and banded appearance characteristic of insects attacked by species of the Entomophthoraceae (FIG. 1, PLATE 9). The flies attacked are the larger black fruit-fly *Drosophila repleta* and to a much less extent the small red-eyed fruit-fly *Drosophila melanogaster*. The circumstances that the flies are attached by means of their proboscides to the substratum, that they show the presence of the fungus only as dorsal bands between the segments of the chitin, and never as a coalescing mass over the abdomen, and that the conidia which are shot off are of the "Truncata-campaniformis-Typus" of Lakon (1919) indicate that the fungus is probably the common species *Empusa Muscae*.

Cytological study of fixed and stained preparations has established without a doubt that the fungus is morphologically identical with the common house-fly fungus which attacks other species of large and small flies, but which has never as yet been described, as far as I can learn from the literature, as occurring on species of *Drosophila*. The physiological identity of the fungus, however, cannot be established with certainty until successful cross inoculations with *Empusa Muscae* from the house-fly to *Drosophila* and *vice versa* are obtained.

¹ Contributions from the Department of Botany of Columbia University, No. 351.

[MYCOLOGIA for March-April (19: 43-96) was issued March 1, 1927]

I have been able to fix successfully and section and stain for cytological study the diseased specimens of *Drosophila* obtained through several seasons. I am presenting and describing the stages of conidiophore formation not heretofore presented in complete detail in sectioned and stained material. Cohn (1855) has described from living material the stages of conidiophore formation. He observed the streaming of the protoplasm upward toward the top of the conidiophore, upon which a cylindrical papilla-like projection soon arose. This projection showed a gradual widening out as it became filled with the inflowing and streaming cytoplasm. The vesicle was finally cut off from the conidiophore by a cross-wall and formed itself into a bell-shaped spore. Vacuoles arose in the massed material left below the cross-wall. Thaxter (1888) describes the formation of the conidium as a bud arising upon the conidiophore which he regards as a basidium. Thaxter claims that the conidium itself is formed within this bud, so that it is surrounded by the conidiophore-membrane as well as by its own membrane. The conidium is thus really of the nature of a single-spored sporangium. Olive (1906b) does not agree with Thaxter, and states that he found no evidence for regarding the spore as a sporangium containing a single spore.

I have found again in these flies the resting-spores of this fungus. The resting-spores as seen in fresh and fixed and stained material correspond in every detail with those I have already described in connection with the studies of this fungus on house-flies (1923).

The material was fixed with Flemming's weak solution, imbedded in paraffin, and the sections cut five microns thick, and stained with the Flemming's triple stain. Care was taken before fixation to remove the head, thorax, wings, and leg parts in order to make the sectioning easier.

When the white bands of conidiophores are visible on the dorsal surface of the fly's body (FIG. 1, PLATE 9), very little trace remains in the interior of the abdomen of any of the internal organs of the fly (FIGS. 2 AND 3, PLATE 9). The intestines and glandular tissues are nearly or entirely gone and only the hyphal bodies, filament fragments, and conidiophores are found. I have not

been able to decide whether the original growth of the fungus here is filamentous or by hyphal body formation. In crushed living material I have found that the hyphal body condition seems to prevail and that where these are rather elongated and branched, and interwoven together, the mass might easily be taken for a mycelial growth. The possibility however remains that a mycelium may first be formed which readily fragments and the individual portions rounding up appear as the hyphal bodies.

In sectioned and stained material, the conidiophores or hyphal tubes arise from the hyphal bodies and are oriented towards the nearest intersegmental membrane through which they can emerge to the exterior. The conidiophores are of an even width, and contain many nuclei (FIG. 4, PLATE 9). In cross-section they appear quite rounded and usually show only a single nucleus in a single section. The conidiophores must exert considerable pressure against the membrane which connects the chitinous segments of the dorsal wall of the abdomen, since in sections of flies in which the conidiophores have not broken through to the exterior, the intersegmental membranes upon which they are pressing bulge outward in a series of convolutions. When the conidiophores have broken through the intersegmental membranes, they appear in section as a cluster of club-shaped projections (FIGS. 2 AND 4, PLATE 9). The broken intersegmental membrane appears as a dark thin line folded back against the thicker chitinous segments on each side. As the hyphae emerge through the spaces between the segments, they become swollen and much larger in cross-section than the basal portions of the conidiophores within the fly's body which are now almost devoid of protoplasm (FIG. 4, PLATE 9).

My sections show that the growth of the conidiophore is not mere apical growth, but actually a migration of the entire protoplasmic content of the conidiophore up the tube so that the membrane is continually being extended upward. As the protoplasm fills this upper region of the tube, the portion of the tube just below and at the point of emergence from the fly's body becomes entirely devoid of protoplasm and appears collapsed. Only the new conidiophores pushing through at these regions are still filled with protoplasm (FIG. 4, PLATE 9).

Although the extreme tip of the conidiophore is filled with cytoplasm, it contains no nuclei (FIGS. 1 AND 2, PLATE 8). The formation of the conidium here is very much like that of *Empusa Sciarae* described by Olive (1906a). He describes the process for that form as follows: "a small protuberance which has a diameter equal to about half that of the conidiophore is pushed out from the end" of the conidiophore. "There is now formed at the apex of this narrow sterigma a swelling which after continued enlargement finally receives the greater part of the protoplasm and all of the nuclear content from the basal portion."

In plate 8, figures 1 and 2, the plasma-membrane has formed a narrow sterigma or elongated region. The growth of this projection is no doubt brought about, as Cohn (1855) described, by the migration upward and into the sterigma of the cytoplasmic and nuclear content of the conidiophore, causing the sterigma to bulge, and thus the conidium is formed. The connecting region or neck, that is the region from which the plasma-membrane started its outward growth to form the conidium, remains practically the same, becoming neither noticeably narrower nor perceptibly wider. Figures 2, 3, and 4 of plate 8 show various stages in the progressive movement outward of the cytoplasmic threads and nuclei. The arrangement of the cytoplasm seems to indicate a gradual drawing away of the moving threads of cytoplasm from the lower conidiophore walls upward toward the tip. When the entire cytoplasmic material has entered the conidium, the swollen tip of the conidiophore now contains only a slight granular matter (FIG. 6, PLATE 8). This is probably of the nature of a waste colloidal material which originally lay in the tube outside of the streaming threads of cytoplasm.

I have not as yet been successful in obtaining preparations which show the formation of this wall or membrane which cuts off the conidium from the conidiophore itself. Olive (1906b) describes the formation of walls in the Entomophthoraceae by means of a cleavage furrow in conidiophores, in vegetative hyphae and in the cutting off of the conidia from the conidiophores. He describes and figures the process as consisting in the formation of a ring-shaped partition which grows inward from the hyphal wall across the vacuolar space of the hypha cutting off one portion of

the hypha from the other. The plasma-membrane first folds inwards, and the young wall is deposited between the two layers as the fold extends inward. The nuclei are described as appearing in a state of rest and therefore not connected closely with the process. Olive states that this may indicate that cell-division here is a cytoplasmic phenomenon. In the case of the abstriction of the conidium from the conidiophore the cleavage furrow formed by the folding inward of the plasma-membrane cuts through the dense cytoplasm which fills the neck connecting the conidiophore with the conidium.

My sections show no indication of a double wall being present around the protoplasm of the spore such as Thaxter describes. The conidium is surrounded by the original cytoplasmic membrane of the conidiophore and is not at all of the nature of a sporangium. In figure 7, plate 8, the fixation has caught the conidiophore in the act of swelling to the point of bursting and the conidium is already somewhat forced out of its position upon the conidiophore tip. The plasma-membrane of the conidiophore is still connected to the conidium though reduced to extreme thinness and is apparently ready to give way.

As shown in figures 6 and 7, plate 8, the mature conidium in all respects resembles that of *Empusa Muscae* upon the common house-fly. In the formation of the secondary conidia, which I have been able to observe in *Empusa Muscae* conidia obtained from *Musca domestica* and *Drosophila repleta*, the process consists of a budding outward from the primary conidium, and the ultimate abstriction of the secondary spore. As Cohn (1855), Thaxter (1888), and Güssow (1917) have already figured such stages, it is not necessary to repeat them. The primary conidial spore when shot off often is enveloped in a layer of gelatinous material, the discharged contents of the conidiophore when it burst and threw off the spore. The conidium, falling upon a suitable medium for germination but not for the penetration of the hypha, will often send out a tiny rounded papilla or projection from the lower side of the conidium. Into this all the contents of the conidium flow enlarging it into a rounded bell-shaped spore which does not show the characteristic papillate tip of the primary conidia of *Empusa Muscae* and which is smaller in size.

Güssow (1917) has erroneously referred to the oil drop in the primary and secondary conidia which can be seen with the low power of the microscope as the nucleus of the spores. As has been shown by Cavara (1899), Olive (1906a), and myself (1923), the conidia of *Empusa Muscae* are multinucleate. In living material the nuclei are invisible. The conidia, hyphal bodies, and conidiophores are rich in oil drops which in the fixed material may be dissolved out completely and leave no trace or remain as rounded areas in the cytoplasm marking the former position of such oil drops. There is no indication in the living hyphae or spores of the nuclei which are seen in fixed and stained sections of the fungus. The nuclei in my photographs of the fungus from stained sections (PLATES 9 AND 10) are clearly evident as dark staining rounded bodies lying in the cytoplasm of the spores, conidiophores, and hyphae.

The resting-spores (FIGS. 8-10, PLATE 8, AND FIGS. 1 AND 3, PLATE 10) that I find in dried specimens of *Drosophila* appear to be of the chlamydospore type such as I figured and described in my previous paper (1923). They are formed by the rounding up of the intercalary or apical protoplasm and occur usually near the external walls of the fly. The thick wall is laid down within the hyphal membrane as is evident in figure 8, plate 8. In figures 8 and 10, plate 8, it is clearly evident that the resting-spores in both these cases have been formed on a conidiophore tube unable to reach the exterior. The thick wall is smooth and unmarked as in the case of the resting-spores of *Empusa Muscae* found in the house-flies. Within the thick wall is a thin plasma-membrane as is evident in the case shown in figure 10, plate 8, where slight shrinkage has occurred.

Contrary to Winter's (1881) report of the finding of resting-spores of *Empusa Muscae* in damp situations out of doors, the resting-spores found in *Drosophila* (as in the case of those I found in dried house-flies) were found when the hyphae in the flies' bodies appeared dried and shriveled. Figure 1, plate 10, shows the dried, shriveled appearance of the conidiophores while within the fly's body the resting-spores are forming. Martin (1924) found the resting-spores of *Empusa Muscae* in a house-fly from which conidia were still being discharged. This is contrary to

my own observation of their occurrence in drying specimens of house-flies and *Drosophila* in which conidial discharge was no longer possible.

As far as I can tell from sectioned material the resting-spores are typical chlamydospores since they appear to be simply rounded portions of the hyphal filaments themselves. The spores seem to be able to germinate quite readily. Figure 10, plate 8, shows a small germ-tube emerging from the resting-spore. Flies showing resting-spores when placed for even a short time in a moist-chamber will show the emptied spore-walls and the long conidiophores growing outward toward the intersegment spaces for the discharge and the formation of the conidia. Figure 3, plate 10, shows a photograph of a portion of a stained section of a *Drosophila* fly which was placed for about half an hour in a moist-chamber before fixation, and as is evident many of the resting-spores present show germ-tubes emerging from the spores.

Throughout the literature of the Entomophthoraceae there seems to be considerable discussion as to what are the distinctive differences between the two genera *Empusa* and *Entomophthora*, and as to whether these two names should be retained, or one or the other should be discarded. Cohn (1855) who was the first to investigate the fungus attacking house-flies named the fungus *Empusa*. Winter (1881) called the house-fly fungus *Entomophthora*. Thaxter (1888) would use the term *Empusa* for all the entomophthorous forms. His reason for this is that the only distinct difference between *Empusa* and *Entomophthora* rests in the digitate conidiophores found in such species of *Entomophthora* as *E. americana* for example. Cavara (1899) was the first to suggest the recognition of nuclear characters of the conidia for distinguishing the genera *Empusa* and *Entomophthora*. Olive (1906a) however does not think this justifiable and uses the term *Empusa* for all of the forms. In my opinion the nuclear number in the conidia and the branching of the conidiophores together are sufficient grounds for distinguishing between these two genera. This basis for classification was first suggested by Nowakowski (1884) and is also advocated by Lakon (1919).

The genus *Empusa*, as represented by the species *Empusa Muscae* which I have studied in house-flies and fruit-fly species,

shows the conidiophores emerging only between the segments of the fly's body on the dorsal surface, and not in a coalescing mass over the insect's body. This is very evident in my photographs of sectioned *Drosophila* flies (FIGS. 2, 3, AND 4, PLATE 9, AND FIG. 1, PLATE 10). The insects attacked by *Empusa* are found attached to the substratum usually by their proboscides. The conidiophores of this genus are unbranched, and appear as simple multinucleate tubes emerging from the fly's body. Such conidiophores are shown in figure 4, plate 9. The conidia are multinucleate as shown in figures 6 and 7, plate 8. I have found resting-spores to be formed as part of the life-cycle of the fly-fungus and this has been confirmed by Martin (1924). Thus the characteristic of no resting-spores given by Lakon (1919) for this genus can no longer stand. The resting-spores of *Empusa Muscae* are shown in figures 8, 9, and 10, plate 8, and in figures 1 and 3, plate 10, for the fungus in *Drosophila* flies, and in figure 4, plate 10, for the fungus in house-flies.

The genus *Entomophthora* of which I have studied two species, *E. americana* and *E. americana* X (Riddle) occurring on species of large flies, shows the conidiophores as a coalescing mass over the body of the insect. This coalescing mass of conidiophores is evident in figure 2, plate 10, outside of the dark broken line which represents the section through the chitinous wall of the insect. The conidiophores in this form are branched and each gives rise to a single conidium containing a single nucleus (uninucleate). Cystidia or sterile hyphae, and rhizoids which attach the dead insect to the substratum are usually present in these forms. The resting-spores of *E. americana* X (Riddle) are shown in figures 2 and 5, plate 10. It seems to me that these characters when compared with those of *Empusa* are sufficient grounds for separating the two genera.

I am presenting below the species of *Entomophthora* upon which cytological study has been done, and also presenting the descriptions of morphological characters of these fungi as found in Thaxter's (1888) and Lakon's (1919) monographs of these forms. I am naming the fungi *Entomophthora* if the authors who studied them cytologically found their conidia uninucleate. If they are described as having multinucleate conidia, I am using the generic

name *Empusa*. In the case of the form that attacks the mosquitoes and gnats, I am using the name *Lamia* as first suggested by Nowakowski (1884). Its conidia are uninucleate or binucleate according to Olive (1906a). Brefeld (1870), Nowakowski (1884), and Lakon (1919) have all advocated separating the form *Empusa Culicis* as a new genus *Lamia*. These authors regard this species as an intermediate genus between the other two genera *Empusa* and *Entomophthora*.

Fungus	Author	Conidiophore Structure. Presence of Cystidia and Rhizoids (Thaxter and Lakon)
<i>Entomophthora Sciaræ</i>	Olive (1906)	Branched conidiophores Cystidia and rhizoids present
<i>Entomophthora delpiniana</i> ..	Cavara (1899)	Conidiophores branched Cystidia present
<i>Entomophthora gloeospora</i> ..	Vuillemin (1887)	Conidiophores branched Rhizoids present
<i>Entomophthora americana</i> ...	Riddle (1906)	Branched conidiophores Rhizoids present
<i>Entomophthora X</i>	Riddle (1906)	Branched conidiophores
<i>Entomophthora geometralis</i> ..	Riddle (1906)	Branched conidiophores Rhizoids present
<i>Entomophthora echinospora</i> ..	Riddle (1906)	Branched conidiophores Rhizoids present
<i>Entomophthora rhizospora</i> ...	Riddle (1906)	Branched conidiophores Cystidia and rhizoids present
<i>Entomophthora Fresenii</i>	Riddle (1906)	Simple conidiophores Cystidia and rhizoids not present
<i>Entomophthora Aphidis</i>	Olive (1906)	Branched or simple conidiophores Cystidia and rhizoids present
<i>Empusa Muscæ</i>	Cavara (1899)	Unbranched conidiophores Cystidia and rhizoids not present
<i>Empusa Grylli</i>	Riddle (1906)	Simple conidiophores Cystidia and rhizoids not present
<i>Lamia Culicis</i>	Olive (1906)	Simple or branched conidiophores Cystidia present (Nowakowski) Cystidia not present (Thaxter) Rhizoids present (Lakon) (Brefeld) Rhizoids not present (Nowakowski)

Now studying the table we note that the only irregularity is in the case of *E. Fresenii*. Riddle (1906) designates this as a form with uninucleate conidia, and Thaxter's (1888) description of it as a fungus with simple conidiophores, and lacking rhizoids and cystidia, would make this seem to upset the classification. However Thaxter (1899) himself states that the position of this form

among species of *Empusa* is only provisional, in that its conidia are smoky tinted and thick-walled, and that they produce peculiar almond-shaped secondary conidia on capillary conidiophores, and the zygospores arise as buds upward from the point of conjugation of gametes arising from two hyphal bodies. For this form and its related form *E. lageniformis*, if the latter should sometime be shown to possess uninucleate conidia also, the genus *Triplosporium* as Thaxter suggests might be advocated.

I am presenting a classification of the parasitic Entomophthoraceae attacking insects. The outline follows that of Nowakowski (1883) and Lakon (1919) considerably. I have added the nuclear condition of the conidia to each group as far as it is known, this being a very decisive factor I believe in the separation of the first three genera. The sequence of the genera is not intended to indicate the evolutionary development of these forms.

ENTOMOPHTHORACEAE—PARASITIC GENERA ATTACKING INSECTS

Empusa:

- Conidia multinucleate.
- Conidiophores simple.
- Cystidia and rhizoids not present.

Lamia—an intermediate genus (Nowakowski (1884)):

- Conidia uninucleate, binucleate, rarely trinucleate.
- Conidiophores simple (Nowakowski) (Olive) (Lakon).
- Conidiophores branched (Brefeld).
- Cystidia present (Nowakowski), not present (Thaxter).
- Rhizoids present (Brefeld) (Lakon), not present (Nowakowski).

Entomophthora:

- Conidia uninucleate.
- Conidiophores digitate.
- Cystidia and rhizoids generally present.

Tarichium—a provisional genus until the conidia are found for its species:

- Resting-spores only are known.

Triplosporium (Thaxter):

- Conidia uninucleate? smoky tinted.
- Conidiophores unbranched.
- Rhizoids and cystidia lacking.
- Zygospores arise as a bud from the point of conjugation between two hyphal bodies.

Massospora:

- Conidia (nuclear condition not known).
- Conidiophores (branching condition not known).
- Conidia formed within host's body and adhering in masses.

SUMMARY

The two fruit-flies *Drosophila repleta* and *melanogaster* are attacked by an Entomophthorous fungus identical in all structural characters with *Empusa Muscae* which attacks the common house-fly *Musca domestica*. Conidium formation, as observed from stained and sectioned material of the *Drosophila* flies dead with the disease, is by means of the moving upward of protoplasmic threads and the many nuclei into a sterigma arising as a bud on the top of the conidiophore tube. When the entire content of the conidiophore has flowed into the sterigma causing it to swell up to form a bell-shaped spore, the conidium is cut off from the emptied conidiophore tube by a cross-wall. Resting spores similar to those found in dried house-flies were also found in connection with the fungus attacking the *Drosophila* species.

I hereby acknowledge my indebtedness to Dr. R. A. Harper for his many valuable suggestions in this study and the preparation of this paper.

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EXPLANATION OF PLATE 8

The drawings were made with the aid of the Abbe camera lucida. A Zeiss microscope was used with a 1/12 in. oil immersion objective and a number 3 ocular. The magnification is about 1200 diameters.

Fig. 1. A conidiophore lying outside of the fly's body. The cytoplasm is somewhat fibrillar in appearance and scattered through it are numerous nuclei.

Fig. 2. The content of the conidiophore has moved along the tube toward the free extremity of the conidiophore, leaving the basal portion of the tube nearer the fly's body devoid of protoplasm. A small sterigma has formed at the free top of the conidiophore.

Fig. 3. The protoplasm of the conidiophore has moved farther down the tube, while the basal portion is beginning to collapse. The young conidium already contains three nuclei.

Fig. 4. The young conidium is growing larger as more of the cytoplasm and the nuclei enter it.

Fig. 5. Nearly all of the nuclei have now entered the conidium, and very little cytoplasm is left in the conidiophore. The young conidium shows the small papilla which is characteristic of the primary conidia of this species.

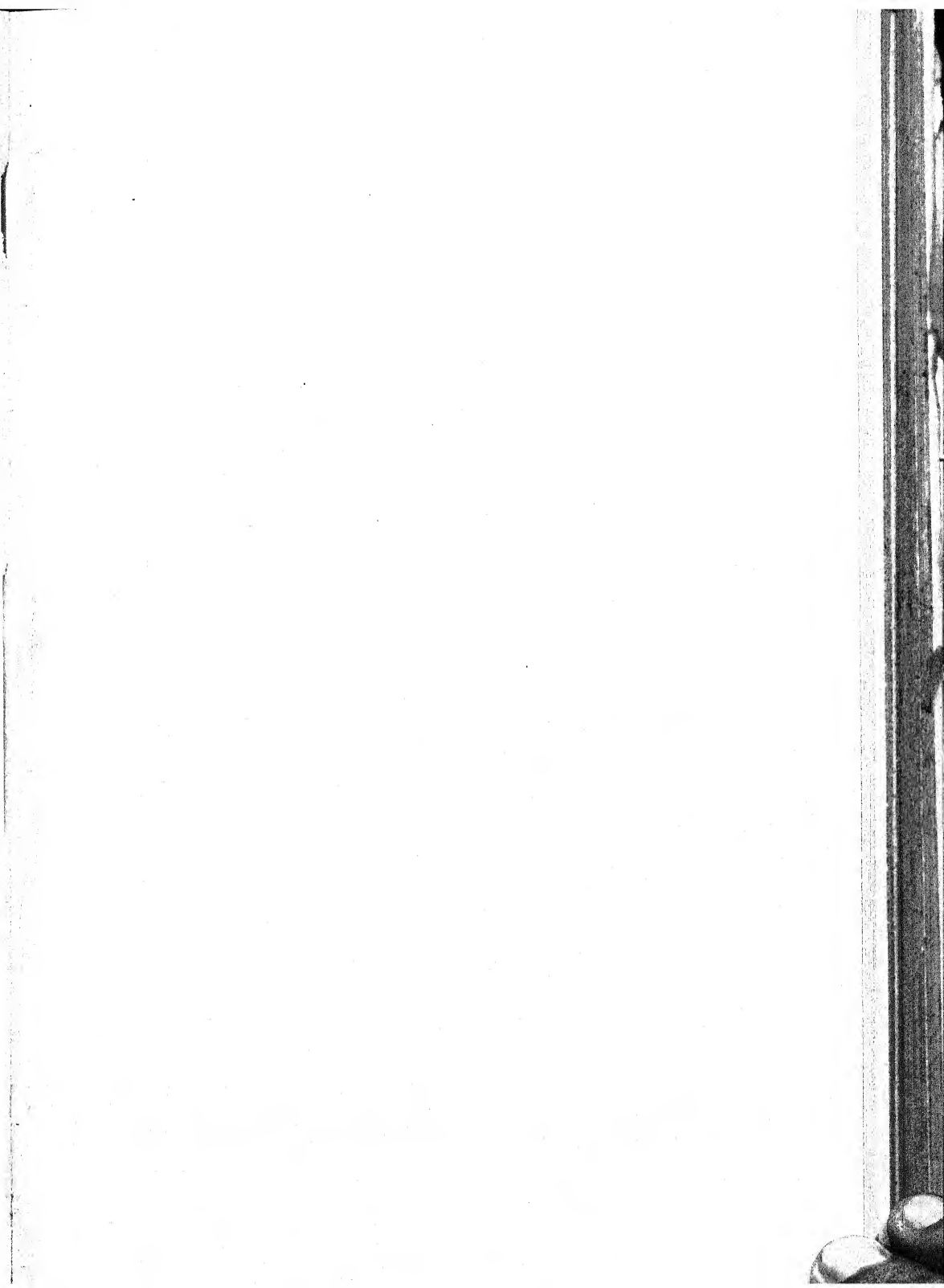
Fig. 6. The conidium is completely formed, and cut off from the conidiophore by a septum.

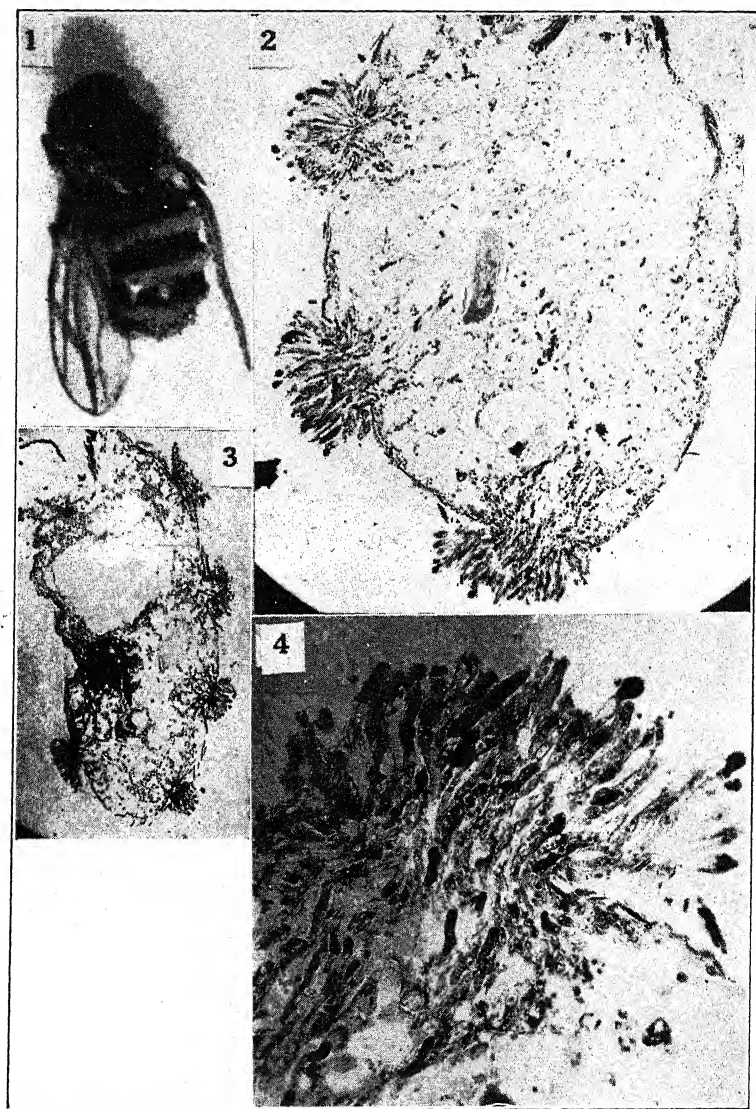
Fig. 7. The mature conidium is breaking away from the conidiophore, whose membrane, still unbroken, appears in the section to be very thin and drawn out.

Fig. 8. A chlamydospore containing eight nuclei, and rounded clear areas marking the position of the oil drops present in living material.

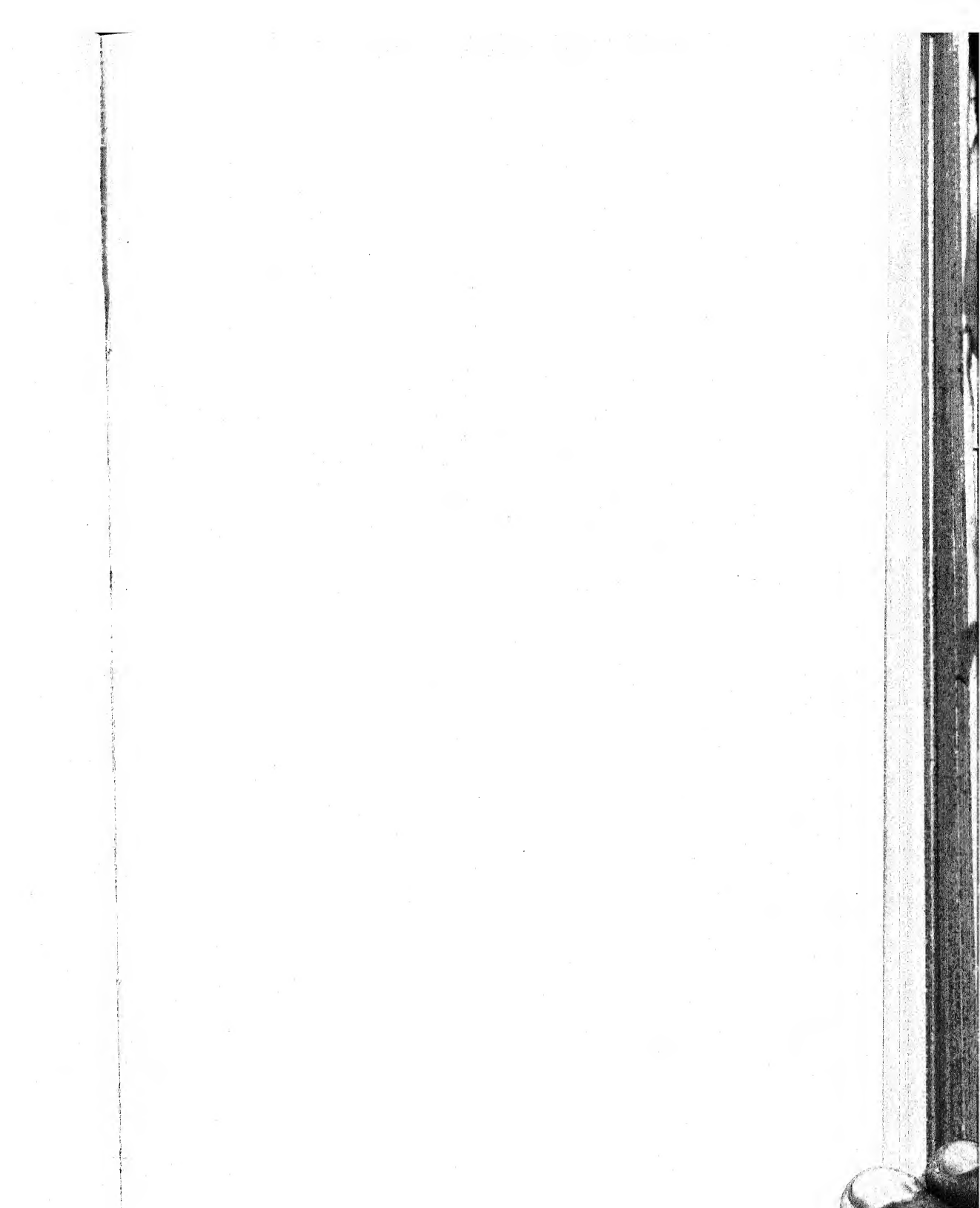
Fig. 9. A rounded resting spore containing seven nuclei.

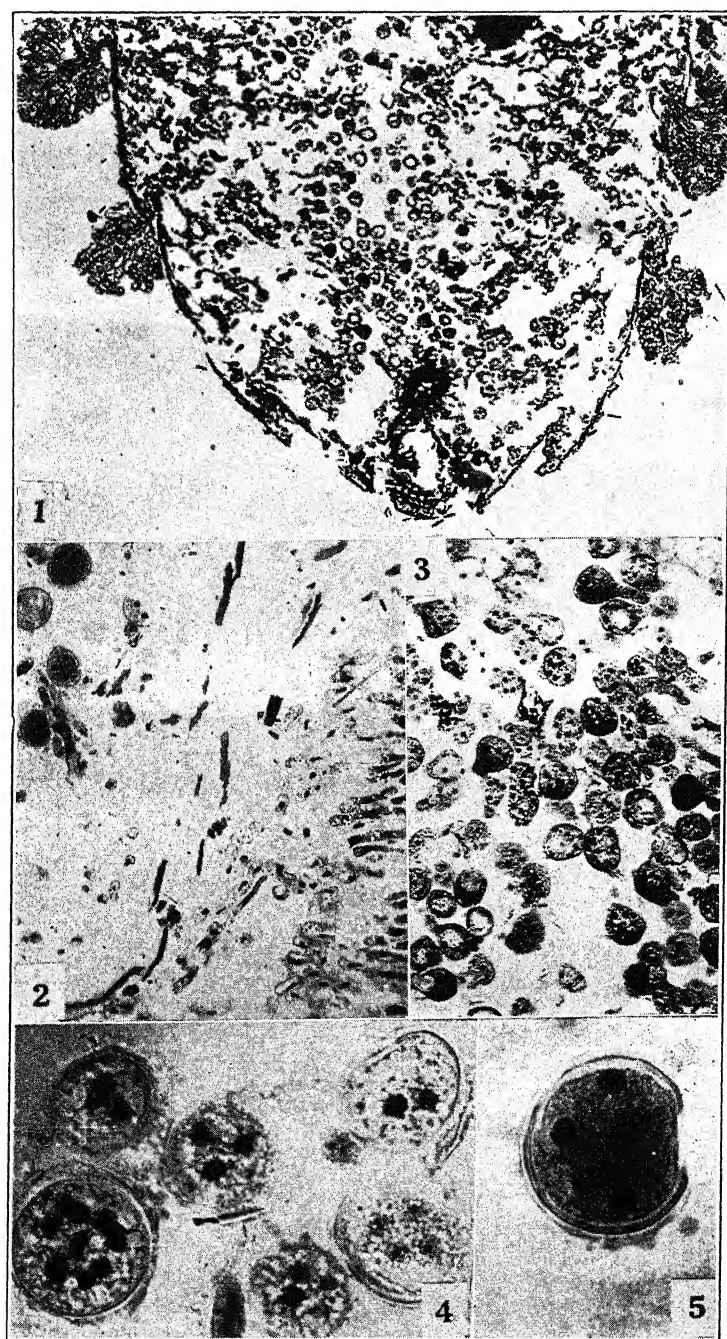
Fig. 10. A rounded chlamydospore with a portion of the emptied tube from which it arose still attached. A small germ tube is present into which one nucleus has already moved out. The thin membrane of the hyphal tube is clearly visible as it surrounds the thicker wall of the resting-spore itself.





EMERGENCE OF CONIDIOPHORES FOR DISCHARGE OF CONIDIA





RESTING-SPORES

EXPLANATION OF PLATE 9

Fig. 1. A photograph of a specimen of *Drosophila repleta* dead with the *Empusa* disease. The abdomen shows the bands of fungus conidiophores as they appear projecting between the dorsal segments of black chitin.

Fig. 2. A photograph of a section 5 μ thick of a fly that has been fixed with Flemming's weak solution, embedded in paraffin, and sectioned and stained with the Flemming's triple stain. The conidiophores are seen emerging from the body, between the segments.

Fig. 3. A similar section through the abdomen showing the conidiophores emerging from the fly's body through the broken intersegmental membranes between the bands of chitin on the dorsal surface of the fly's body.

Fig. 4. A group of conidiophores seen in section as they emerge through the broken intersegmental membrane between the two dorsal segments of chitin. Several stages in conidium formation are shown, as well as the presence of great numbers of nuclei in the cytoplasm of the conidiophores, and the unbranched condition of the conidiophores.

EXPLANATION OF PLATE 10

Fig. 1. A photograph of the section of a fly's abdomen showing the conidiophores dried and shriveled. Resting-spores are forming within the insect's body.

Fig. 2. Resting-spores of *Entomophthora americana* X (Riddle) lying within the body. The chitinous body wall broken in sectioning is here shown as a series of broken heavy lines. The conidiophores which form a coalescing mass over the abdomen of the fly are also shown. The conidiophores are the ultimate branches of those which left the fly's body. Each now contains a single large nucleus, and will form a conidium at its tip containing all the cytoplasm of the tube and the single nucleus.

Fig. 3. Germinating resting-spores of *Empusa Muscae* within a *Drosophila* fly after lying within a moist-chamber for half an hour.

Fig. 4. Resting-spores of *Empusa Muscae* found within the body of a dried house-fly. The walls of the spores are smooth, but appear irregular due to the remains of the collapsed hyphal membranes about them.

Fig. 5. Resting-spore of *Entomophthora* X (Riddle) showing the presence of bullate thickenings on its wall. The spores of this fungus were found within the abdomen of a dried flower-fly (*Calliphora erythrocephala*) attached to the flowers of *Rubus laciniatus*.

NOTES ON THE PARASITIC FUNGI OF ILLINOIS—III

L. R. TEHON AND E. Y. DANIELS

(WITH PLATE 11)

The material from which this paper is drawn consists of the incidental collections of the Illinois State Natural History Survey's botanists. Submitted as a contribution toward cataloging the fungous flora of the world, as well as of Illinois, it contains an account of five Ascomycetes and twenty-nine imperfect fungi.

In the treatment of the Fungi Imperfecti, it is now—as it has been—customary to regard them as separable species when they inhabit distinctive hosts or when they manifest tangible differences in morphology; and the custom is not without its advantages, despite the adverse criticism which has been heaped upon it, for it emphasizes in the matter of “fundamental,” or “genetic,” species an intimate interdependence of fungus and host that has been demonstrated more often than disproved. Moreover, though we may envision an ultimate phylogenetic taxonomy, we are still too poorly advanced in research to invent a more practical device for perpetuating a knowledge of the imperfect forms. If the time comes when we are able to list the thallic connections of the Ascomycetes with all their spore forms, there will be needed still, for purposes of description, differentiation, and recognition, a classification of the imperfect ones, which, though possibly simpler, must yet take cognizance chiefly of their morphism, their coloration, and their limits of parasitism.

The specimens, which are in the Survey's Mycological Collection, are designated especially by accession numbers; and when, upon request, portions of them are sent elsewhere, the labels will bear those numbers.

Phyllachora Cinnae Tehon & Daniels, n. sp.

Follicolous; spots diaphyllous, extensive, longitudinal, straw-colored stripes which become confluent laterally and at the ends,

and so involve all the leaf tissue. Stromata abundant, lying in longitudinal rows between the veins, elongate-elliptic in outline, $0.1-0.2 \times 0.5-2$ mm., the largest containing about 16 ascigerous locules arranged in two parallel rows of 8 each, the locules united above by an epiclypeus which lies in the epidermal layer, but generally separate below except in a small central part where the stroma is loosely developed into an indefinite hypoclypeus. Locules spherical, paraphysate, $75-125 \mu$ in diameter. Asci long-cylindric, short-stipitate, $6-12 \times 60-70 \mu$. Paraphyses filiform, slightly exceeding the asci. Spores hyaline, continuous, uniseriate, often lying nearly horizontally in the ascus, short-oblong to very broadly oval, $3.5-4 \times 6-9 \mu$. PLATE 11, FIG. 1.

On *Cinna arundinacea*.

Granite City, Madison County, August, 1920. Acc. No. 9316 (type).

Nitschkia Polygoni Tehon & Daniels, n. sp.

Caulicolous; inhabiting the cortical cells through several internodes. Cells of the epidermis, cortex, phloem, and cambium parasitized and occupied by the abundant mycelium, but not disorganized. Perithecia very abundant, spherical to applanate, $150-300 \mu$ in diameter, cespitose, 4 to 12 or more in a group, and frequently united by a dense, brown subiculum covering their lower third; the groups irregularly distributed and crowded. Ostiole rostrate, up to 45μ high and $15-30 \mu$ broad, protruding through the cuticle. Asci saccate to broadly obclavate, short-stipitate, $35-60 \mu$ long by $15-22 \mu$ wide, 8-spored. Paraphyses filiform, exceeding the asci. Spores continuous, hyaline, ellipsoid, often with one end nearly acute, $6-8 \times 12-16 \mu$. PLATE 11, FIG. 2.

On *Polygonum* sp.

Villa Ridge, Pulaski County, June 21, 1925. Acc. No. 9239 (type).

Stigmathea Plantaginis Tehon & Daniels, n. sp.

Foliicolous; spots diaphyllous, at first small and brown, later white throughout and friable, eventually crumbling away, irregular, $0.25-5$ mm. wide; margin dark brown, very narrow, raised. Perithecia developed beneath the cuticle, membranous but very dark, spherical, opening epiphyllously, paraphysate, $130-160 \mu$ in diameter. Ostiole present, variable, $8-14 \mu$ wide, practically non-functional, the perithecia eventually becoming erumpent and widely fissured. Asci oblong-cylindric, apically

obtuse and thickened, $50-70 \times 8-10 \mu$, rather short-stipitate, opening by a pore. Spores hyaline, spindle-shaped, equally or nearly equally 1-septate, biseriate, $10-17 \times 3-3.6 \mu$. Paraphyses filiform, hyaline, exceeding the asci.

On *Plantago virginica*.

Carthage, Hancock County, July 24, 1922. Acc. No. 7652 (type).

Rostrosphaeria Tehon & Daniels, n. gen.

Perithecia glabrous, subcarbonous to carbonous, spherical to applanate, innate in the host tissue, not erumpent, with a long, straight, rostrate ostiole. Asci thickened apically, with an apical pore, 8-spored. Spores hyaline, 1-celled. Paraphyses simple, septate.

This genus belongs in the Gnomoniaceae and is closely similar to both *Gnomoniella* and *Campiosphaeria*, being distinguished from the former by the presence of paraphyses and from the latter by its straight, ostiolar rostrum. It is based on the following species.

Rostrosphaeria Phlei Tehon & Daniels, n. sp.

Follicolous; inhabiting the dead leaves of the previous year. Spots absent. Perithecia very abundant, without a stroma, lying in rows between the veins, developing in and occupying the mesophyll, erumpent amphiphylly by means of a long, rostrate ostiole, spherical to applanate, $170-350 \mu$ wide, membranous, becoming carbonous with age, paraphysate. Ostiole erumpent through the epidermis, $105-210 \mu$ long, $60-150 \mu$ wide at the base, tapering somewhat. Asci abundant, clavate, long-stipitate, bluntly rounded and thickened at the apex, with a pore through which the spores escape, $60-80 \times 14-17 \mu$. Paraphyses very numerous, coarsely filiform, unbranched, several septate, not exceeding the asci, $2 \times 50-75 \mu$. Spores hyaline, continuous, fusiform, granular, arranged in 2 spiral rows, $12-18 \times 4-5 \mu$. PLATE 11, FIG. 3.

On *Phleum pratense*.

Jacksonville, Morgan County, July 25, 1925. Acc. No. 893 (type).

Exilispora Tehon & Daniels, n. gen.

Sphaeriaceous. Perithecia glabrous, membranous, coriaceous, or carbonous, spherical to applanate, paraphysate. Ostiole rostrate. Spores dark, scoleciform.

This genus, based on the following species, is very close to *Ophiobolus* in its morphology; but it is quite distinct, for among the heterogeneous *Ophioboli* now known no species serves as an intermediate or connecting form. In the Saccardian system, it becomes the only genus falling definitely in the Phaeoscoleciae of the Sphaeriaceae. It is separated from *Rhyncosphaeria*, of the Phaeophragmiae, only by its definitely scoleciform spores.

***Exilispora plurisepta* Tehon & Daniels, n. sp.**

Caulicolous, not maculicolous or on cankers, on much of the length of the stem. Perithecia in linear rows between the strands of sclerenchymatous fiber, numerous, often contiguous and appearing joined, lying beneath the epidermis, through which their ostioles protrude, or exposed by its exfoliation, spherical to applanate, membranous to carbonous, 200–350 μ in diameter, with a short, conically tapered, ostiolar rostrum; seated upon a loose, indefinite subiculum. Asci cylindric to clavate, very long-stipitate, 75–110 \times 10–15 μ , 8-spored. Ascospores scoleciform, 10–20-septate, ends tapering, olivaceous to brown, 65–80 \times 3–4 μ , lying in a single bundle within the ascus. Paraphyses filiform, abundant, much exceeding the asci, hyaline. PLATE 11, FIG. 4.

On *Erigeron* sp.

McNabb, Putnam County, June 28, 1922. Acc. No. 8404 (type).

***Phyllosticta Porteri* Tehon & Daniels, n. sp.**

Spots irregularly circular, apparent on both sides of the leaf, 2–10 mm. in diameter or, by confluence, becoming very much larger, often marginal though not usually so; upper surface dark tan to brown with faintly marked concentric rings, emarginate except for a water-soaked band 0.5 mm. wide which, in the dry specimen, appears dark grey with a reddish tinge; lower surface tan to cinereous, concolorous, the water-soaked margin faintly visible and the bordering veinlets red-tinted. Pycnidia non-carbonous, 90–150 μ in diameter, lying in the mesophyll, erumpent, protruding slightly below, causing noticeable distensions of the upper surface, one or two developing in each areola but lying near the veinlets, not restricted to the center of the spot but usually centered there. Ostiole round, 7.5 μ wide in smaller pycnidia, 22 μ wide in the largest ones. Spores hyaline, eguttulate, allantoid, 2 \times 4 μ .

On *Syringa vulgaris*.

Oregon, Ogle County, August 26, 1922. Collected by Dr. C. L. Porter. Acc. No. 3097 (type).

Four species of *Phyllosticta* have been reported on this host; but this one is distinct enough to deserve separate recognition. They may be separated as follows:

Spores 10 to 20 μ long.

Spores 5 to 7 μ wide.....*P. Halstedii*.

Spores 2 μ wide.....*P. syringicola*.

Spores 5 to 10 μ long.....*P. Syringae*.

Spores 5 μ long or less

Spores globose, pycnidia carbonous.....*P. syringophila*.

Spores allantoid, pycnidia non-carbonous.....*P. Porteri*.

Phyllosticta Gymnocladi Tehon & Daniels, n. sp.

Spots circular, 0.5–3 mm. in diameter, diaphyllous, the centers crumbling away with age, light tan to cinereous above with a very narrow but marked dark-purple margin, tan below with a diffused purple margin. Pycnidia epiphyllous, crowded, ostiolate, globose to strongly applanate-globose, membranous when young but carbonous when old, lying in the palisade tissue, often thickened above so as to appear slightly rostrate, not or only very inconspicuously clypeate, 70–135 μ in diameter. Ostiole piercing the epidermis, protruding slightly, 15–22 μ wide. Locule corresponding to the pycnidium in size and shape, at first filled with a hyaline pseudoparenchyma, later with spores embedded in a gelatinous matrix. Conidiophores absent. Spores hyaline, continuous, globose, broadly elliptical or ovate, not guttulate, 4.5–9 \times 4–6.5 μ , arising simultaneously with the histolysis of the local pseudoparenchyma. PLATE 11, FIG. 5.

On *Gymnocladus dioica*.

Lawrenceville, Lawrence County, August 27, 1925. Acc. No. 10319 (type).

We place this species in *Phyllosticta*, though understanding clearly that its morphological characters should place it in *Phyllostictina*. For the latter genus there are now three conflicting concepts: First, the original one of Sydow,¹ based upon the morphology of the specimen which became the monotype of the genus, of a pycnidium filled with a pseudoparenchyma whose histolysis gives rise to the spores; second, that of von Höhnelt,²

¹ Sydow, H. & P., & E. J. Butler. Fungi Indiae orientalis. Ann. Myc. 14: 185–186. 1916.

² Höhnelt, F. von. Ueber Phyllostictina Murrayae Sydow. Ann. Myc. 18: 93–95. 1920.

also probably based upon the monotype, of a pycnidium filled with a pseudoparenchyma subject to histolysis but with spores borne upon simple, mostly short, and evanescent conidiophores; third, that of Shear,³ based in part upon von Höhnel's concept, of a pycnidium morphologically the same as von Höhnel's but "restricted in its application to the pycnidial forms of the genus *Guignardia*, as applied to species congeneric with the common *G. Bidwellii*." *Phyllostictina* now contains the following species: *P. Murrayae* Syd. (the type), *P. uvicola* (Berk. & Curt.) v. Höhnel, *P. carpogena* Shear, and *P. Vaccinii* Shear. According to Shear, *Phyllosticta solitaria* Ellis & Ev. and *Phyllosticta congesta* Heald & Wolf should be included also. Guba,⁴ in his detailed study of *P. solitaria*, concludes that that species is not admissible to Sydow's concept but may be admissible to von Höhnel's. The same should hold true for *Phyllosticta congesta*, on the basis of Roberts' ⁵ statement of its similarity to *P. solitaria*. Shear's figures and description of *Phyllostictina carpogena*, as well as his slides, show that it is not congeneric with *Phyllostictina* Sydow, or with *Phyllostictina* Sydow, emend. v. Höhnel, and may not be consistent with his stated concept of that genus: First, in having functioning conidiophores; second, in having persistent conidiophores; and third, in being neither congeneric with a type nor the as yet proved conidial stage of a *Guignardia*.

Respecting the species involved, the fact seems apparent that there are two groups, characterized generally as being pycnosclerotic but distinguishable as follows:

1. Sporophores absent, spores liberated through the histolysis of a pseudoparenchyma, pycnidia functioning soon after formation and ceasing to function with the discharge of the one spore crop. Including *Phyllostictina Murrayae* Syd. and *Phyllosticta Gymnocladi* T. & D.

2. Sporophores developing subsequent to the histolysis of a pseudoparenchyma, pycnidia functioning after a period of dor-

³ Shear, C. L. Life histories and undescribed genera and species of fungi. *Mycologia* 15: 129-131. 1923.

⁴ Guba, E. F. *Phyllosticta* leaf spot, fruit blotch, and canker of the apple: its etiology and control. Univ. of Ill. Agr. Exp. Sta. Bull. No. 256. 1925.

⁵ Roberts, J. W. Plum blotch, a serious disease of the Japanese plum, caused by *Phyllosticta congesta*. *Jour. Agr. Res.* 22: 365-370. 1921.

mancy and then without mechanical limitation; spores provided with a mucous appendage. Also normal *Phyllosticta* pycnidia functioning immediately after development. Including *Phyllosticta solitaria* Ellis & Ev. and probably also *P. congesta* Heald & Wolf, *Phyllostictina uvicola* (Berk. & Curt.) v. Höhnelt, *P. carpogena* Shear, and *P. Vaccinii* Shear.

Group 1 is equivalent to *Phyllostictina* Sydow, the second species being, by comparison, wholly congeneric with the monotype. Group 2 requires further analysis but could be grouped in a genus based on the dormant pycnosclerotia or left in *Phyllosticta* on the basis of the non-dormant sporulation. In any event, von Höhnelt's emended *Phyllostictina*, applying neither to the monotype nor to apparently related species, and being drawn quite as much from suppositions as from facts, must be ignored: it should have no taxonomic standing.

It seems, too, that no significance should attach either to proved or to supposed relations between imperfect fungi and ascomycetous genera as factors delimiting genera in the Fungi Imperfecti, for it is imperative that morphology alone furnish such distinctions.

Phyllosticta solidaginicola Tehon & Daniels, n. sp.

Spots diaphyllous, circular, 1-5 mm. in diameter, cinereous, friable, definitely limited by a narrow, raised, purple border. Pycnidia few, scattered, hypophyllous, limited to the epidermal layer, globose to applanate-globose, carbonous, ostiolate, 75-130 μ in diameter; walls thin, black; clypeus absent; ostiole erumpent, never rostrate, 12-15 μ wide. Spores continuous, hyaline to smoky, ellipsoid, 2-3 \times 4-6 μ , granular. Conidiophores simple, filiform, 2-15 μ long, arising laterally and basally in the pycnidium

On *Solidago* sp.

Sumner, Richland County, August 27, 1925. Acc. No. 10114 (type).

The species of *Phyllosticta* occurring on *Solidago* may be distinguished as follows:

Occurring on insect galls. *P. gallicola*.

Not on galls.

Spores pedicellate. *P. sphaeropsispora*.

Spores not pedicellate.

Spores $5-6 \times 10-15 \mu$ *P. similispora*.

Spores $2-3 \times 4-6 \mu$ *P. solidaginicola*.

***Phyllosticta nymphaeicola* Tehon & Daniels, n. sp.**

Spots oval to round, lying between the veins, 3-8 mm. wide by 5-15 mm. long, often confluent, diaphyllous, concolorous, dark brown above with a straw colored area connecting neighboring spots, lighter brown below and appearing silvery. Pycnidia strictly hypophyllous, few, scattered, immersed, membranous, spherical to slightly applanate, $110-135 \mu$ in diameter; ostiole slightly raised, protruding through the epidermis, becoming carbonous with age, $12-15 \mu$ wide. Conidia bacilliform, oblong, with rounded ends, hyaline to smoky, continuous, exuding in cirrhi, $2-2.5 \times 2.5-5 \mu$.

On *Nymphaea advena*.

Olney, Richland County, August 28, 1925. Acc. No. 11093 (type).

This and the other three *Phyllostictae* occurring on this host may be distinguished as follows:

Pycnidia epiphyllous, or amphigenous; spots concentrically marked.

Pycnidia small ($60-80 \mu$), spores $2-3 \times 7-10 \mu$ *P. nymphaeaceae*.

Pycnidia large (up to 100μ), spores $3-4 \times 6-10 \mu$ *P. fatiscens*.

Pycnidia very large ($150-180 \mu$), spores $1.5-2 \times 5-7 \mu$ *P. hydrophila*.

Pycnidia strictly hypophyllous, spots concolorous, spores

$2-2.5 \times 2.5-5 \mu$ *P. nymphaeicola*.

***Phyllosticta glycineum* Tehon & Daniels, n. sp.**

Spots diaphyllous, 1-5 mm. in diameter, subcircular, cinereous, deciduous, purple-bordered. Pycnidia amphiphyllous, globose to somewhat applanate, membranous, $90-170 \mu$ in diameter, immersed; ostiole protruding slightly, $10-20 \mu$ wide, becoming carbonous. Spores oblong to narrowly ellipsoid, with rounded ends, continuous, hyaline to smoky, $2-2.5 \times 4.5-7 \mu$, exuding in cirrhi.

On *Glycine hispida* (soybean).

Arthur, Douglas County, July 6, 1925. Acc. No. 4392 (type).

This species may be identical with *P. decidua* Ellis & Kellerm. as now understood and may be only of accidental occurrence on soybean. Besides the current doubt that *P. decidua* is a homogeneous species, certain distinctions of a morphological and physiological nature may be held to justify segregation, such as

the larger spots, larger variation in pycnidial size, larger and more nearly bacilliform spores, and the fact that *P. decidua* is not yet reported on any *Leguminosae*.

Spore size would seem to indicate identity with *P. phaseolina* Sacc., but gross and microscopic comparisons of the two (we have collected the latter several times on cowpea) reveal striking dissimilarities of aspect.

Phyllosticta plantaginicola Tehon & Daniels, n. sp.

Spots diaphyllous, circular to subcircular, 0.5–5 mm. in diameter, dark brown when young, becoming cinereous, papery, depressed, and fragile with age, sometimes confluent; margins dark brown, narrow, prominently raised. Pycnidia few—2 or 3 in the usual spot, scattered, protruding epiphyllously and becoming semi-exposed through the collapsing of dead leaf tissue, carbonous, 120–180 μ in diameter, developing in and occupying the mesophyll, spherical to broadly applanate-globose; ostiole not rostrate, only very slightly raised, at first hardly protruding, 20 μ wide. Spores oblong to elliptic, rarely ovoid, appearing hyaline individually but in groups (as in cirrhi) having a decided olivaceous tint, continuous, $3\text{--}4 \times 7\text{--}8 \mu$.

On *Plantago virginica*.

Marshall, Clark County, July 18, 1925. Acc. No. 3188 (type).

This species is very close to *Phoma paradoxa* Kab. & Bub. in habit and superficial aspect; but the spore size and shape are distinctive, those of the *Phoma* measuring $2.5\text{--}3.5 \times 12\text{--}15 \mu$. Distinction is easily made from the two other *Phyllostictae* on species of *Plantago*:

Pycnidia 60–100 μ in diameter, spores 2–3 μ wide.

Spores elongate, allantoid, up to 9 μ long. *P. plantaginella*.

Spores short, oblong to ovoid, up to 5 μ long. *P. Plantaginis*.

Pycnidia 120–180 μ in diameter, spores 3–4 μ wide, oblong to

elliptic, 7–8 μ long. *P. plantaginicola*.

Phyllosticta avenophila Tehon & Daniels, n. sp.

Spots diaphyllous, very extensive, one half to several cm. long, half as wide or fully as wide as the leaf, cream colored to pale yellow, unlimited, emarginate. Pycnidia numerous, on the sides of the veins, in closely clustered rows which are widely scattered over the spot, spherical to slightly applanate, somewhat rostrate, occupying the mesophyll, protruding epiphyllously,

darkly membranous to carbonous, 70–100 μ in diameter; ostiole round, 10–15 μ wide; rostrum 15–20 μ high, 12–20 μ broad, completely erumpent. Spores hyaline, continuous, mostly appearing biguttulate, oval to elliptic, $3-4 \times 6.5-8 \mu$.

On *Avena sativa*.

Piper City, Ford County, June 19, 1925. Acc. No. 2415 (type).

***Phyllosticta menispermicola* Tehon & Daniels, n. sp.**

Spots diaphyllous, light brown to tan, circular when small, very irregular when large, 5 mm. to 5 cm. wide, with a slightly raised, dark, red-brown margin 1 mm. wide; on the under side darker and nearly concolorous. Pycnidia few, sparsely scattered over most of the spot, though occasionally in small clusters, spherical to somewhat applanate, distinctly membranous, lying in the mesophyll, 75–110 μ in diameter, opening epiphyllously by means of a slightly protruding, round to oval ostiole 10–17 μ wide. Spores hyaline to greenish, uniformly oval, continuous, not guttulate, $3.5-4 \times 3-3.5 \mu$.

On *Menispermum canadense*.

Porterfield, Marshall County, August 22, 1922. Acc. No. 8039 (type).

Comparison of this material with the type specimen of *Phyllosticta abortiva* Ellis & Kellerm., furnished through the courtesy of the New York Botanical Garden, which is also on this host, reveals the fact that the earlier species, said to have "spores imperfectly developed," is not a *Phyllosticta* but a *Septoria*. We redescribe it as follows:

***Septoria abortiva* (Ellis & Kellerm.) Tehon & Daniels, n. comb.,**
description emended.

Synonym: *Phyllosticta abortiva* Ellis & Kellerm. Jour. Myc. 1: 4. 1885.

Spots diaphyllous, subcircular to somewhat angular, 0.25–1.5 cm. wide, dark grayish-brown above with a definite, blackish, slightly raised border 0.5 mm. wide, grayish-green below with a very narrow margin. Pycnidia abundant, scattered thickly throughout the spots, spherical, innate, occupying the mesophyll, membranous, 60–85 μ in diameter, opening epiphyllously through a very slightly raised, large, round ostiole usually half as wide as the pycnidium; mostly sterile. Spores acicular, hyaline, continuous to 4-septate, straight or curved, $17-23 \times 1-1.5 \mu$.

On *Menispermum canadense*.

W. A. Kellerman, No. 702, Manhattan, Kansas, Nov. 1884 (type; also the type of the synonym). In the herbarium of the New York Botanical Garden.

Phyllosticta illinoensis Tehon & Daniels, n. sp.

Spots diaphyllous, subcircular, becoming dehiscent, 3–4 mm. in diameter, brown to cinereous above, tan below, margin dark brown. Pycnidia few to many, scattered, occupying the mesophyll, spherical to applanate-globose, membranous, 70–120 μ in diameter, opening through either epidermis by a round, slightly protruding, somewhat carbonous ostiole 10–20 μ wide. Spores bacillar, oblong, straight, ends obtuse, hyaline to smoky, continuous, 3–5 \times 2 μ ; issuing from mature pycnidia in fuliginous cirrhi.

On *Sassafras variifolium*.

Grand Tower, Jackson County, August 17, 1922. Acc. No. 574 (type). Also at Coxeyville, Monroe County, August 24, 1922. Acc. No. 5096.

It has seemed best to make this species distinct from *P. Sassafras* Cooke. Current specimens of Cooke's species are sterile, thus permitting no accurate comparison; but a comparison of the description of his species and our specimens presents inconsistencies of pycnidial size, and of spore shape and size, sufficient to warrant specific segregation, as may be seen in the following:

Pycnidia up to 100 μ in diameter; spores ellipsoid-lanceolate,	
1.5 \times 7 μ	<i>P. Sassafras</i> .
Pycnidia up to 120 μ in diameter; spores bacillar-oblong,	
2 \times 3–5 μ	<i>P. illinoensis</i> .

Phyllosticta circuligerens Tehon & Daniels, n. sp.

Foliicolous; spots diaphyllous, brown to almost black, 1 mm. to 1 cm. in diameter, unlimited, without margins, by confluence involving the entire leaf blade, becoming friable and eventually crumbling away, strongly marked with concentric ridges between which the leaf tissue has collapsed. Pycnidia few, irregularly scattered, developed in and occupying the mesophyll, apparent amphiphyllosly as protrusions in the collapsed tissue, opening hypophyllosly by a non-rostrate, slightly carbonous ostiole, membranous and yellow, not carbonous except a small circle about the ostiole, 75–165 μ in diameter. Ostiolar opening ir-

regularly circular, 14–21 μ wide. Spores hyaline, continuous, oval to oblong, with rounded ends, $3\text{--}4 \times 3.7\text{--}8 \mu$.

On *Rumex altissimus*.

Dongola, Union County, August 12, 1922. Acc. No. 1007 (type).

***Phyllosticta chenopodiicola* Tehon & Daniels, n. sp.**

Foliicolous; spots several per leaf, diaphyllous, 2–4 mm. in diameter, circular, definitely limited, emarginate, light tan to cinereous, not friable. Pycnidia few per spot, gregarious, closely crowded in the center of the spot, developed in and occupying the spongy parenchyma of the leaf, opening epiphyllously by means of a non-rostrate ostiole 7–10 μ wide which lies in a small, carbonous clypeus beneath the cuticle, spherical to applanate, 75–90 μ in diameter. Spores continuous, hyaline, $2\text{--}2.5 \times 4\text{--}8 \mu$, straight, oblong, with rounded ends, borne on hyaline, needle-like conidiophores 12–20 μ long. PLATE 11, FIG. 6.

On *Chenopodium album*.

Lincoln, Logan County, July 22, 1925. Acc. No. 6309 (type);
Mason City, Mason County, July 22, 1925. Acc. No. 10190;
Nashville, Washington County, August 13, 1925. Acc. No. 16667.

The *Phyllostictae* occurring on *Chenopodia* may be distinguished as follows:

Spores monomorphic.

Spores curved.

Spores allantoid.

Spores $3 \times 5 \mu$, pycnidia 50 μ in diameter. *P. Chenopodii*.

Spores $1.5 \times 4\text{--}5 \mu$, pycnidia 70–80 μ in diameter. *P. ambrosioides*.

Spores merely curved, cylindric-ovate. *P. Atriplicis*.

Spores straight, oblong, $2\text{--}2.5 \times 4\text{--}8 \mu$, pycnidia 75–90 μ

in diameter. *P. chenopodiicola*.

Spores dimorphic. *P. dimorphospora*.

***Macrophoma Zeae* Tehon & Daniels, n. sp.**

Spots diaphyllous, very extensive, 3–4 cm. wide, 5–10 cm. or more long, irregular in shape, tan with a slightly darker margin, unlimited. Pycnidia abundant, occurring throughout the spot, round to oval or even lenticular in cross section, spherical to applanate in long section, developing in and occupying the mesophyll, membranous, becoming carbonous with age, 65–120 μ in diameter; ostiole protruding hypophyllously, usually through a

stoma, non-rostrate, oval, $15-17 \times 28-35 \mu$. Spores continuous, hyaline to greenish, fusiform, $6.5-8.5 \times 17-31 \mu$.

On *Zea Mays*.

Bushton, Coles County, July 29, 1925. Acc. No. 1247 (type).

***Sirococcus Phlei* Tehon and Daniels, n. sp.**

Caulicolous. Not maculicolous. On dead stems through their length. Pycnidia abundant, in longitudinal rows lying in the chlorenchymatous prosenchyma, usually closely appressed to the intervening sclerenchymatous strands, spherical to applanate, not erumpent, membranous to dark brown, $75-225 \mu$ in diameter, protruding only very slightly by a circular ostiole $25-50 \mu$ wide. Spores catenulate, continuous, hyaline, very broadly oval, $2.5-4 \times 4.5-8 \mu$, borne on hyaline, clavate conidiophores $4-6 \mu$ long.

On *Phleum pratense*.

New Berlin, Sangamon County, July 25, 1925. Acc. No. 14799 (type).

***Cytospora sambucina* Tehon & Daniels, n. sp.**

Caulicolous; producing extensive, oval, yellowish to cinereous cankers which, by confluence, occupy large portions of the internodes. Stromata numerous, irregularly scattered, not crowded, erumpent through the cuticle by a black, compound ostiole $\frac{1}{4}-\frac{3}{4}$ mm. wide, developed in and occupying the cortex between the cuticle and the xylem, the mycelium dissolving and destroying all the cells of the invaded portion. Locules several per stroma, irregularly shaped, with individual ostioles; walls indefinite and membranous toward the periphery of the stroma but elsewhere definitely carbonous. Spores hyaline, allantoid, non-septate, $4-6.5 \times 1-2.5 \mu$.

On *Sambucus canadensis*.

Oregon, Ogle County, August 26, 1922. Acc. No. 7426 (type).

***Cytospora sassafrasicola* Tehon & Daniels, n. sp.**

Caulicolous; inhabiting the bark of small branches previously injured by fire. Cankers not evident. Stromata thickly distributed through the internodes, $275-675 \mu$ in diameter, diffuse and membranous toward the base, black, compact and carbonous at the apex, developed in and occupying the cortex beneath the epidermis, the mycelium disorganizing the cortical cells and infrequently occupying the epidermal cells. Locules few, extensive, irregularly shaped, about $100-375 \mu$ broad, opening by

separate ostioles which converge toward the erumpent center of the stroma. Spores continuous, allantoid, hyaline, 3-7.5 \times 1.5-2.5 μ .

On *Sassafras variifolium*.

Olney, Richland County, June 14, 1924. Acc. No. 12161 (type).

SPHAEROPSIS SMILACINA Peck

On *Smilax hispida*.

Boaz, Massac County, Acc. No. 1127; Buncombe, Johnson County, Acc. No. 2509; Eagle Mountain, Saline County, Acc. No. 14420; Anna, Union County, Acc. No. 306; Seymour, Champaign County, Acc. No. 10733.

Dearness,⁶ after an extensive examination of type specimens, has concluded that this is but one of the polymorphs of *Phyllosticta smilacina* (Peck) Dearn., for which he gives an extensive synonymy including forms described as, or thought to be, *Ascochyta*, *Sphaeropsis*, *Stagonospora*, *Phoma*, *Macrophoma*, and *Phyllosticta*. Unfortunately, transference of the specific name used under *Sphaeropsis* by Peck to *Phyllosticta* introduces a conflict with *P. smilacina* Speg.⁷ published in 1899. As we adhere to the dictum that the classification of the Fungi Imperfecti is entirely artificial and based, between genera at least, wholly upon morphology, we prefer to retain the original combinations as designations of the several polymorphs, if such they are, recognizing only the morphology exhibited by an individual and ignoring demonstrated or supposed genetic connections between them.

The fungus, as we find it in Illinois, bears continuous, distinctly colored, brownish-yellow spores, which are not admissible to the usual concept of *Phyllosticta* but which coincide with Peck's description and are admissible to *Sphaeropsis*.

Sphaeropsis Ampelopsidis Daniels, n. sp.

Caulicolous; inhabiting extensive areas on dead stems. Spots and cankers absent. Pycnidia numerous, spherical to applanate, 300-450 μ in diameter, developed in and occupying the cortical tissues beneath the corky exfoliation, closely gregarious in groups

⁶ Mycologia 9: 351-352. 1917.

⁷ Fung. Argent. novi vel crit., p. 315. 1899.

which are widely spaced, often contiguous and the walls then confluent; the groups erumpent through the bark and visible as small warts. Ostiole very slightly raised, round, 15–35 μ wide. Spores oblong, with rounded ends, continuous, dark-olivaceous or brown, 17–25 \times 7–10 μ .

On *Ampelopsis quinquefolia*.

Fisher, Champaign County, October 20, 1925. Acc. No. 2541 (type).

Sphaeropsis Profundae Tehon & Daniels, n. sp.

Foliicolous; spots diaphyllous, 1–3 per leaf, circular, tan, 0.5–1 cm. in diameter, with a distinctly brown border 0.5 mm. wide, often surrounded by a chlorotic halo 1–3 mm. wide, becoming friable and crumbling away in age. Pycnidia few, usually 10 or 12 per spot, arranged in an indefinite circle toward the periphery, lying in the mesophyll and opening amphiphyllously by a slightly protruding ostiole, membranous to carbonous, spherical to applanate, 150–200 μ in diameter; the ostiole uniformly 15–18 μ wide. Spores oblong or broadly ovate, dark brown, usually biguttulate, often appearing slightly allantoid in profile, 14–25 \times 7–11 μ .

On *Fraxinus profunda*.

Fountain Bluff, Jackson County, June 20, 1924. Acc. No. 17554 (type).

This differs from *S. pennsylvanica* Berk. & Curt. in pycnidial and spore characters, and is certainly different from *S. hyalina* Berk. & Curt. which is now properly known as a *Macrophoma*.

Ascochyta Elymi Tehon & Daniels, n. sp.

Foliicolous; spots dark brown, long and narrow, parallel and adjacent ones often involving large areas of the leaf, causing it to wilt and die at the tip. Pycnidia few per spot, in longitudinal rows between the leaf veins, circular in cross section and conic-truncate in long section, wall very thin, membranous, scarcely distinguishable, with sporiferous mycelium localized in the base of the pycnidium, 60–120 μ in diameter, developed in and occupying the mesenchyma from epidermis to epidermis. Ostiolar opening poorly defined, up to 30 μ wide, protruding through the epidermis, openings amphiphyllous. Spores hyaline, varying from oblong to spindleform, usually straight, but often curved, 1-septate, the septum strictly median, each cell provided with a single guttulum, 10–14 \times 2–3 μ .

On *Elymus virginicus*.

Jacksonville, Morgan County, July 25, 1925. Acc. No. 3334 (type).

The distinction between this species and *A. graminicola* Sacc. lies in its pycnidia, the walls of which are very thin and scarcely distinguishable, in contrast with the distinctly parenchymatic, fuliginous ones of Saccardo's species.

Ascochyta biguttulata Daniels, n. sp.

Follicolous; spots diaphyllous, white to tan, angular, up to 1 mm. broad, becoming confluent and forming circular spots 1 cm. or more wide, friable with age and crumbling away. Pycnidia abundant, scattered throughout the spot, developed in and occupying the mesophyll, spherical to applanate, 75–150 μ (mostly 100 μ) in diameter, membranous, opening hypophyllously by a circular, very slightly protruding, concolorous ostiole quite uniformly 15–16 μ wide. Spores hyaline, very regularly and symmetrically navicular-fusiform, uniformly and very distinctly biguttulate, excepting rarely the largest 3-guttulate, the guttules often 2–2.5 μ in diameter, 3–4 \times 8–14 μ , becoming 1-septate at maturity. PLATE 11, FIG. 7.

On *Polygonum Convolvulus*.

Urbana, Champaign County, October 11, 1925. Acc. No. 2438 (type).

Diplodia Sambuci Tehon & Daniels, n. sp.

Caulicolous; inhabiting extensive cankers, in company with a *Cytospora*, on small and medium sized twigs. Pycnidia spherical, carbonous, 150–225 μ in diameter, erumpent through the cuticle by a slightly raised ostiole whose opening is 15–20 μ wide, very abundant, irregularly scattered, developed in and occupying a dense hyphal subiculum which lies just below the cuticle, parasitizing, dissolving, and destroying the cells of the epidermis, the cortex, and the cambium. Spores narrowly elliptic, olivaceous to brown and in age not translucent, 1-septate, slightly constricted at the septum, 7.5–10 \times 14–21 μ .

On *Sambucus canadensis*.

Oregon, Ogle County, August 26, 1922. Acc. No. 7073 (type).

Septoria festucina Tehon & Daniels, n. sp.

Follicolous; spots diaphyllous, brown, at first limited laterally by the veins, 1–10 mm. long, later often involving entire leaves

and killing them. Pycnidia numerous, often crowded and contiguous, developed in and occupying the mesophyll, brown, membranous, opening amphiphylously; small ones spherical and about $75\ \mu$ in diameter; large ones compressed laterally, lying in 2 rows between the veins, and reaching a length of $225\ \mu$. Ostiole round or oval, conforming to the shape of the pycnidium, not rostrate, hardly protruding, $15\text{--}30\ \mu$ wide. Spores hyaline, acicular, straight or curved, non-septate, $35\text{--}70 \times 1\text{--}1.5\ \mu$.

On *Festuca elatior*.

Tallula, Menard County, June 16, 1922. Acc. No. 9224 (type).

Our belief that this *Septoria* is not *S. Tritici* is prompted by a wide acquaintance with that fungus and finds further support in the narrow host range shown for it by Weber.⁸ As illustrated by Sydow's Mycotheca Germanica No. 1185, *S. Festucae* Died. is certainly distinct. The species now reported on *Festucae* can be separated as follows:

Spores $30\ \mu$ or more long.

Spores septate.

Spores 3-septate, $32\text{--}40\ \mu$ long.....*S. Festucae-sylvaticae*.

Spores 3-7-septate, $40\text{--}70\ \mu$ long.....*S. Tritici*.

Spores not septate, $35\text{--}70\ \mu$ long.....*S. festucina*.

Spores short, $15\text{--}25\ \mu$ long.....*S. Festucae*.

Labrella Aspidistrae Tehon & Daniels, n. sp.

Foliicolous; not maculicolous; occupying the entire leaf blade and petiole, which it kills. Diseased leaves not shrunk or rotted, but lax and wilted, becoming light tan to cinereous when dried. Pycnidia amphigenous, produced in great abundance throughout the diseased tissue, irregularly scattered, subcircular to oval in outline, $140\text{--}150\ \mu$ in diameter, flat, membranous, developed in and occupying the mesophyll of the leaf, opening by a linear slit which splits the pycnidium into nearly equal halves. Spores oblong to obclavate, hyaline, continuous, $10\text{--}18 \times 3.5\text{--}4\ \mu$, borne on short, simple, hyaline conidiophores $2.5\text{--}5\ \mu$ long.

On *Aspidistra* sp.

Libertyville, Lake County, June 9, 1922. Acc. No. 7648 (type).

Pestalozzia Heucherae Tehon & Daniels, n. sp.

Foliicolous; spots diaphyllous, dark brown, circular, with a darker, red-tinted, narrow, raised margin, $1\text{--}3\ \text{mm.}$ in diameter,

⁸ Phytopathology 12: 537. 1922.

generally isolated but capable of confluence and then destroying large areas of leaf tissue; concolorous above and below. Acervuli developed in the mesophyll, visible amphiphyllously because of the shrinking of parasitized tissue, opening strictly epiphyllously, often crowded in the spot, membranous, 75–150 μ in diameter. Spores mostly 4-septate, rarely 3-septate, fusiform, in profile somewhat falcate, slightly constricted at the septa, 14–25 \times 5–7 μ ; central cells dilute brown with dark brown septa and lateral walls; terminal cells hyaline with hyaline walls, the basal one long-conic and drawn out into a single hyaline bristle 10–20 μ long and 0.5 μ wide, the apical cell short-conic with 2 or rarely 3 spreading, hyaline bristles 10–20 μ long and 0.5 μ wide. Conidiophores hyaline, cylindric, with tapered apex, 2–8 μ long. PLATE 11, FIG. 8.

On *Heuchera parviflora*.

Fountain Bluff, Jackson County, June 20, 1924. Acc. No. 2873 (type).

Septocylindrium Hydrophylli Daniels, n. sp.

Follicolous; spots diaphyllous, at first round, 1–3 mm. in diameter, black, becoming extensive, irregular, friable, and occupying large areas of the leaf, which eventually fall away. Fasciculae very few, hypophyllous, small, loose, consisting of 3–10 hyphae. Conidiophores hyaline, minute, nonseptate, simple, erect, straight, 4–12 \times 2.5–3 μ . Spores hyaline, bacilliform to oblong-cylindric, non-septate *in situ*, catenulate in 2 rows from the apex of the conidiophore, 7–15 \times 2.5–3 μ . PLATE 11, FIG. 9.

On *Hydrophyllum canadense*.

Seymour, Champaign County, October 15, 1925. Acc. No. 9531 (type).

Cercospora Hyperici Tehon & Daniels, n. sp.

Follicolous; spots diaphyllous, chiefly near the margins, circular when small, extending circularly over the blade until the midvein is reached, dark brown above and concolorous, lighter brown below, unlimited and without a margin, 1–4 mm. wide, sometimes confluent. Fasciculae strictly hypophyllous, very abundant, crowded in the center of the spot, of 3–50 or more conidiophores, which arise from a prominent, cellular tubercle. Conidiophores upright, straight below but tortuous above from spore abscission, continuous, olivaceous, without geniscars, 14–20 \times 3–4 μ . Spores hyaline, subcylindrical to obclavate, straight, ends obtuse but not blunt, continuous to 4-septate, 15–25 \times 3–4 μ .

On *Hypericum adpressum*.

Bement, Piatt County, July 6, 1925. Acc. No. 13035 (type).

***Cercospora Podophylli* Tehon & Daniels, n. sp.**

Foliicolous; spots diaphyllous, round or elongate, 0.5–1 mm. wide, 0.5–10 mm. long, cinereous, with a narrow, brown, limiting margin; subject to invasion by an *Alternaria*, which results in extensive foliar necrosis. Fasciculae absent. Conidiophores appearing singly or in pairs, strictly epiphyllous, subhyaline to olivaceous, 2–3-septate, clavate, apex obtuse; geniscars absent. Spores hyaline, long-cylindric to navicular, both ends acute, 3–5-septate, $35\text{--}55 \times 3\text{--}6 \mu$.

On *Podophyllum peltatum*.

Jersey County, August 2, 1922. Acc. No. 12950 (type).

***Cercospora Silphii* Ellis & Ev. var. *laciniati* Tehon & Daniels, n. var.**

Foliicolous; spots dark brown to black, usually near or on a large vein, angular, 1–3 mm. wide, distinctly hypertrophied. Fasciculae rare, small, of from 4 to 7 hyphae. Conidiophores upright, light-olivaceous, 1–3-septate, $30\text{--}50 \times 3.5\text{--}4.5 \mu$. Spores hyaline or nearly so, straight or curved, somewhat obclavate, 6–10-septate, $70\text{--}90 \times 3.5\text{--}4 \mu$.

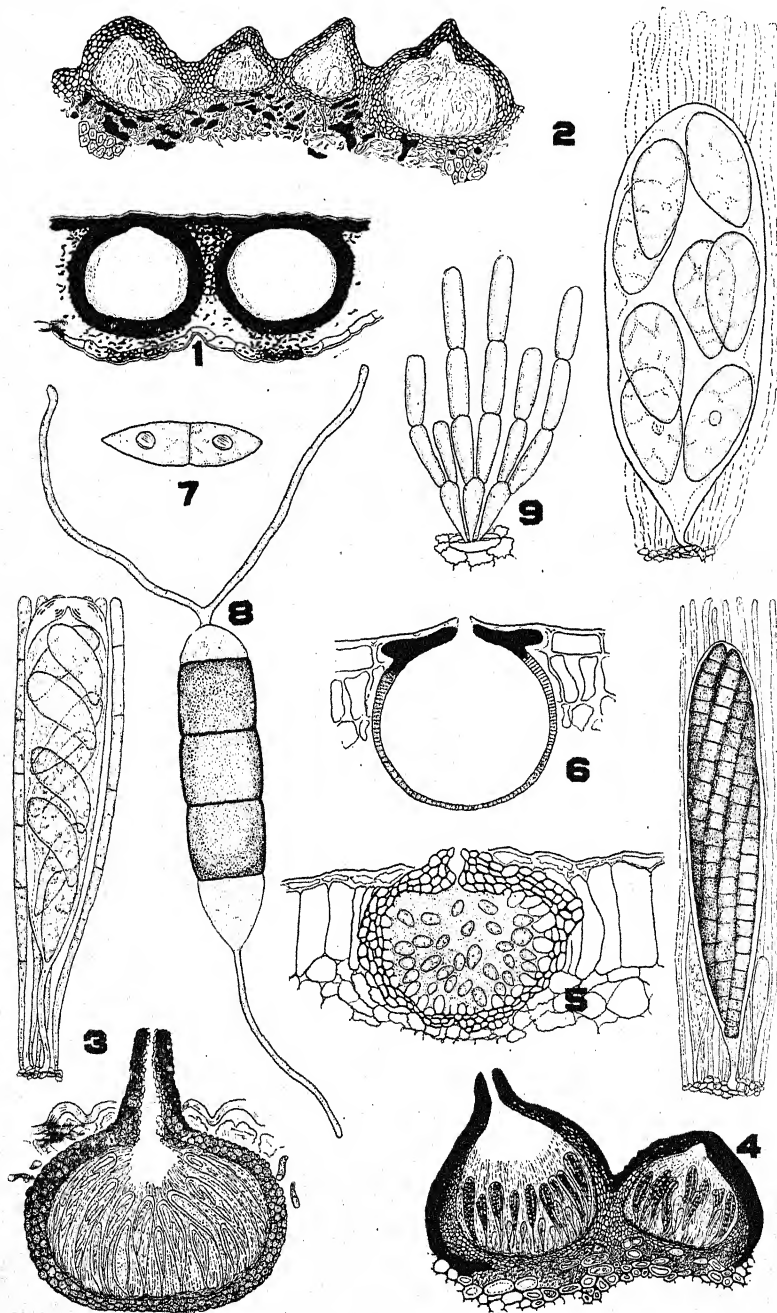
On *Silphium laciniatum*.

Bement, Piatt County, July 6, 1925. Acc. No. 15262 (type).

This differs but slightly from the species, and then in respect especially to the conidiophores and spores. The difference in spots is probably ascribable to host reaction.

***Cercospora setariicola* Tehon & Daniels, n. sp.**

Foliicolous; spots at first small, broadly oval, dark brown, lying between the larger veins, 0.5–1 mm. long, becoming elongate-elliptic with a cinereous, nonfriable center and an unraised, sharply limited, brown border; sometimes confluent. Fasciculae strictly hypophyllous, erumpent in rows through the interveinular stomata, not numerous or crowded, composed of 50 or more conidiophores which arise from a dark, compact, oval, flat tubercle measuring $15\text{--}17 \times 30\text{--}36 \mu$. Conidiophores straight, erect, continuous or 1-septate, $17\text{--}40 \times 3\text{--}4 \mu$, translucent, light olivaceous, tapering to a definitely conic apex, with small but marked internal geniscars. Spores straight or sometimes



slightly curved, acicular, hyaline, 4-12-septate, $30-90 \times 3-4 \mu$; geniscar small but marked, internal.

On *Setaria glauca*.

Macomb, McDonough County, August 16, 1924. Acc. No. 11542 (type); Oquawka, Henderson County, August 15, 1924. Acc. No. 7905.

This species is readily distinguishable from the two other ones now known on *Setariae*, as the following shows:

Conidiophores long, 50-120 μ .

Spores $20-150 \times 4-5 \mu$ *C. Setariae*.

Spores $45 \times 1.5 \mu$ *C. striaeformis*.

Conidiophores short, 17-40 μ *C. setariicola*.

In fact, its characteristics are essentially those of a *Scoleotrichum*, except for its undoubtedly scoleciform spores.

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EXPLANATION OF PLATE 11

Fig. 1. Cross section of the stroma of *Phyllachora Cinnae*, showing the opposite locules, the well developed epiclypeus, and the indefinite hypoclypeus.

Fig. 2. Ascus and spores of *Nitschkia Polygoni*; also a section through a group of perithecia which shows the hyphal subiculum upon which they rest.

Fig. 3. Ascus and a section of a perithecium of *Rostrosphaeria Phlei*.

Fig. 4. Ascus and spores, and a section of two joined perithecia of *Exiliospora plurisepta*.

Fig. 5. Section through a pycnidium of *Phyllosticta Gymnocladi*.

Fig. 6. Diagrammatic section of a pycnidium of *Phyllosticta chenopodiicola*, showing the clypeus about the ostiole.

Fig. 7. A spore of *Ascochyta biguttulata*.

Fig. 8. A spore of *Pestalozzia Heucherae*.

Fig. 9. A fascicle and spores of *Septocylindrium Hydrophylli*.

CONTRIBUTIONS TO OUR KNOWLEDGE OF OREGON FUNGI—II MYCOLOGICAL NOTES FOR 1925

S. M. ZELLER

(WITH 3 TEXT FIGURES)

In continuation of previous notes on Oregon fungi¹ I am presenting here a list of fungi which have never been reported from the state before or concerning which some notes of interest have been obtained.

PHYCOMYCETES

Family 1. PERONOSPORACEAE

1. PLASMOPARA RIBICOLA Schröt.
On gooseberry, Coquille. June. No. 2505.

ASCOMYCETES

Family 2. ERYSIPHACEAE

2. ERYSIPHE CICHORACEARUM DC.
On *Phlox* sp., Corvallis. July. No. 2362.
3. ERYSIPHE POLYGONI DC.
On *Polygonium*, Corvallis. August. No. 2542.
4. PHYLLACTINIA CORYLEA (Pers.) Karst.
On cultivated filbert, leaves affected near the ground, Hood River. November. No. 2608.

Family 3. SPHAERIACEAE

5. FRACCHIAEA CALLISTA (Berk. & Curt.) Sacc.
On bark of *Cornus*, Corvallis. April. No. 2002.
6. VALSA ABIETIS Fries.
On *Pseudotsuga taxifolia*, Corvallis. December. No. 2507.

¹ Zeller, S. M. Contributions to our knowledge of Oregon fungi—I. *Mycologia* 14: 173-199, fig. 1-6. 1922.

7. *VALSA AMBIENS* Fries.

On apple, Alvadore. February. No. 2494.

8. *EUTYPELLA PRUNASTRI* (Pers.) Ellis & Ev.

On winter-injured apple bark, Hood River. March. No. 2458.

9. *VALSELLA PAPYRIFERAE* (Schw.) Berl. & Vogl.

In apple bark, Hood River. January. Frequently on winter-injured bark. No. 6867.

The Oregon collections are as near to the above as any reported species. Unfortunately the description is incomplete and if the present collection is to be included the following notes should amend the description:

Stroma circular, with 7-10 perithecia, seated on a white stroma limited by a black exterior; perithecia globose with a neck; asci 16-spored, $50-60 \times 10-13 \mu$; spores hyaline, allantoid, $8-11 \times 1.5-2 \mu$.

10. *EUTYPA FLAVOVIRESCENS* (Hoff.) Sacc.

On dead wood, Corvallis. Infrequent. February. No. 6887.

11. *EUTYPA LATA* (Pers.) Tul.

On dead hard wood, Blue River. March. Epling No. 610.

12. *DIATRYPE BULLATA* Fries.

On alder, Corvallis. March. Infrequent. No. 6888.

13. *CHAETOMIUM GLOBOSUM* Kunze.

On pear canker, Grants Pass. September. No. 2364.

14. *ROSELLINIA PULVERACEA* (Ehr.) Fuckel.

On decay wood (*Quercus*), Philomath. Common. Epling No. 553.

15. *ANTHOSTOMA GASTRINUM* (Fries) Sacc.

On alder?, Blue River. Infrequent. March. Epling and Shorett No. 664.

16. *XYLARIA HYPOXYLON* (L.) Grev.

On cultivated gooseberry in several localities in the Willamette Valley. April. No. 2528.

This species has been found as a root rot of the cultivated gooseberry producing the characteristic black root rot with heavy,

black encrustations of the affected roots as described for the black root rot of apple.² The stag-horn conidial and ascigerous fruiting bodies appear at the ground line around the affected plants. When one root is affected the branches on that side of the plant may have small yellowed leaves, which drop early, and such branches die before the next season.

17. *XYLARIA POLYMORPHA* (Pers.) Ellis & Ev.

On roots of apple tree, Corvallis. March. Infrequent. No. 2273.

18. *XYLARIA RHOPALOIDES* (Kunze) Mont.

On rotted wood. Corvallis. March. Frequent. No. 2274.

19. *USTULINA VULGARIS* Tul.

On decayed wood, Corvallis. March. Infrequent. No. 2234.

20. *HYPOXYLON ATROPURPUREUM* Fries.

On alder, Corvallis. October. Infrequent. Epling No. 237

"This species does not seem to be well understood by any authors of *Exsiccati*. It closely resembles a form collected by E. A. Burt and referred to *H. atropurpureum* by him."—Epling.

21. *HYPOXYLON COHAERENS* (Pers.) Ellis & Ev.

On *Quercus*, north of Corvallis. August. Frequent. No. 1807.

22. *HYPOXYLON FUSCUM* (Pers.) Ellis & Ev.

On dead alder, Corvallis. March. Common. No. 2256, 2485.

23. *HYPOXYLON MULTIFORME* Fries.

On alder, Alsea Mountain and Corvallis. March. Infrequent. No. 6889, 6900.

24. *NUMMULARIA BULLIARDI* Tul.

On dead oak bark, Corvallis. April. Frequent. No. 6886.

Characterized by the broad black stroma which has at the margins the remnants of the thick coriaceous, membranaceous veil which originally covers the stroma.

25. *NUMMULARIA PUNCTULATA* (Berk. & Rav.) Sacc.

Blue River. Collected by Epling and Shorett, No. 565. March.

² Fromme, F. D., & H. E. Thomas. Black root-rot of the apple. Jour. Agr. Res. 10: 163-174. 1917.

26. GNOMONIA ALNI Plowr.

On *Alnus oregona*, Corvallis. October. No. 2515, 2453.

27. GNOMONIA RUBI Rehm.

On dead canes of black and red raspberry and loganberry, Corvallis and Springbrook. Frequent. January to June. No. 2472, 2643, 2655.

Overholts (Mycologia 18: 34. 1926) has recently reported this fungus from Vermont, it having been previously reported from the Eastern states by Edgerton (Bull. Torrey Club 34: 593. 1907). This, however, is the first report of the organism from the western United States.

The specimens found have not been in a parasitic condition. The canes affected have been previously killed, perhaps by winter injury. The fungus is rather typical. Perithecia $200-240 \times 160-200 \mu$; asci 4-spored, $50 \times 6-9 \mu$; spores $12-16 \times 2.5-4 \mu$, one-septate. In one case on black raspberry the acervuli of a *Myxosporium* was associated with the perithecia. These acervuli were creamy-waxy, $50-100 \mu$ broad, circular to elliptic, conidiospores ellipsoid, hyaline, not guttulate or granular, $7-9 \times 2-3 \mu$.

28. GNOMONIA SETACEA (Pers.) Ellis & Ev.

On loganberry, Corvallis. January. No. 2472.

29. APIOSPORA POLYPORI Ellis & Ev.

On *Fomes applanatus*, Corvallis. March. Infrequent. No. 2259.

30. MYCOSPHAERELLA BRASSICAECOLA (Duby) Lindau.

On broccoli leaves, Roseburg. March. No. 2525.

31. BERTIA MORIFORMIS (Tode) De-Not.

On maple wood, Benton County. Infrequent. Epling No. 270.

32. MELANOPSAMMA POMIFORMIS (Pers.) Sacc.

On winter-injured apple bark, Corvallis. December. No. 2487.

33. SPHAERULINA INTERMIXTA (Berk. & Br.) Sacc.

On cultivated black raspberry, Corvallis. January. Common. No. 2477, 2659.

This species is reported from Europe on *Rubus laciniatus* var.

fruticosus and *R. Idaeus*. It perhaps is widespread in America. The spores are strikingly similar to those of some species of *Mycosphaerella* except they are 3-5-septate, $16-23 \times 6-9 \mu$.

34. *SPHAERULINA TAXI* (Cooke) Massee.

On leaves of *Taxus baccata*, Corvallis. February. Infrequent. No. 6879.

This causes a disease of the leaves of yew, which are browned, after infection. The Oregon material is typical, having 8-spored asci, with spores 3-4-septate, hyaline, $16-20 \times 5-7 \mu$.

35. *PLEOSPORA HERBARUM* (Pers.) Rabenh.

On *Asparagus* and *Rubus* stems, Hood River and Gresham. Frequent. March and April. No. 2656, 6894.

36. *LEPTOSPHAERIA AGMINALIS* Sacc. & Morth.

On *Clematis*, Ashland. September. No. 2581.

37. *Leptosphaeria Arunci* n. sp.

Perithecia dark brown to black, erumpent, scattered, globose to slightly depressed, $120-240 \mu$ in diameter, with slightly papil-

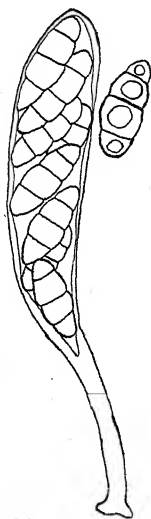


FIG. 1. Ascus and ascospores of *Leptosphaeria Arunci* Zeller.

late ostiole $16-24 \mu$ in diameter; *paraphyses* filiform, hyaline, granular-guttulate; *asci* exceedingly clavate, the long, narrow

stipe with granular, hyaline endoplasm, $88-115 \times 10-13 \mu$. Spores dark brown, eight, crowdedly distichous above to obliquely monostichous below, 3-septate, constricted, guttulate, $18-24 \times 7-9 \mu$ (TEXT FIG. 1).

On dead stems of *Aruncus silvester*, Multnomah Falls. April. (Type in Zeller Herb. 6811 and in O. A. C. Herb. 4851.)

38. LEPTOSPHERIA THOMASIANA Sacc. & Roum.

On dead loganberry canes, Corvallis. February. No. 2460.

This fungus causes gray patches on the canes. These are dotted with the black erumpent perithecia in the central portions but toward the margin of the patches are found pycnidia of a *Phoma* having conidia measuring $3-6.5 \times 2-3 \mu$. This association of *Phoma* with this *Leptosphaeria* is almost constant but its organic connection has never been demonstrated.

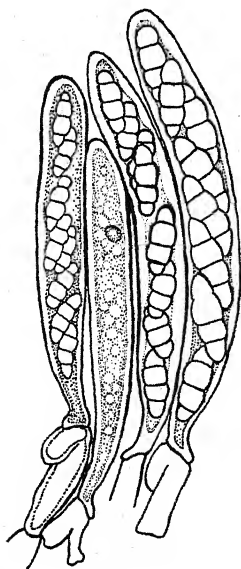


FIG. 2. Immature and mature asci of *Leptosphaeria thomasi* Sacc. & Roum.

The perithecia are gregarious, globose to broadly conic, with very obtusely papillate ostiole, dark brown to black, erumpent, $160-340 \mu$ in diameter; asci terete to narrowly clavate, short-stipitate, $75-96 \times 8.5-12 \mu$; spores 1-2-seriate, olivaceous, fusoid, 3-septate, slightly constricted at maturity, $17-22 \times 6.5-8 \mu$.

The illustration (TEXT FIG. 2) shows immature and mature asci as they arise from the crest of hooks from the ascogenous hyphae.

In western Washington a cane blight has been ascribed to this *Leptosphaeria* under the name *L. Coniothyrium*. The latter species has never been found by the writer in its ascogenous stage in western Oregon or Washington, although the imperfect stage (*Coniothyrium Fuckelii* Sacc.) was found on a dead cane of the Cuthbert red raspberry at Corvallis and on Himalaya blackberry and Cumberland black raspberry at Newberg. Material sent from the Western Washington Experiment Station, Puyallup, Washington, March 3, 1917, under the name of "Loganberry gray bark disease" proves to be *Lepotosphaeria Thomasiana*. The two common fungi on *Rubus* canes in western Oregon and Washington to which a cane blight might be attributed are *Mycosphaerella rubina* (Peck) Jacz. and *Ascospora Rubi* (West.) Zeller. The *Phoma* and *Coryneum* stages, respectively, of these are more commonly found than their ascogenous stages and much more commonly than the rarely found *Coniothyrium*.

39. DIDYMELLINA IRIDIS (Desm.) v. Höhn.

On *Iris*, Brooks. April. Common. No. 6828.

40. MELANOMMA PULVIS-PYRIUS (Pers.) Fuckel.

On dead poplar wood, Corvallis. November. Infrequent. Epling No. 264.

Family 4. HYPOCREACEAE

41. HYPOMYCES LACTIFLUORUM Schw.

On *Russula delica*, Benton County (Alsea Mountain). August. No. 2548.

42. NECTRIA DEPAUPERATA Cooke.

On *Kentia* palm, Portland. Collected by H. S. Jackson (O. A. C. Herb. 1844).

43. NECTRIA PUNICEA Fries.

On *Juglans*, Corvallis. February. No. 6875.

Perithecia are dark purplish red and spores are $16-23 \times 6-7.5 \mu$.

Family 5. DOTHIDEACEAE

44. *Plowrightia ribesia* (Pers.) Sacc.

On cultivated currant, Corvallis, Woodburn, Springbrook. December to April. Frequent. No. 2473, 2529, 2533.

45. *Plowrightia morbosa* (Schw.) Sacc.

On *Prunus emarginata*, Benton County. April. Frequent. (Epling.) No. 2292.

Family 6. HYSTERIACEAE

46. *Hypoderma virgultorum* DC.

On canes of red raspberry, Alpine, Gresham, and Newberg. March to May. Frequent. No. 6916, 6895, 6901.

The perithecia are shiny black, lenticular, opening by a longitudinal slit. Asci are stipitate clavate, $95-125 \times 7.5-9 \mu$; spores at first 1-celled, then 2-celled, 2-guttulate, $17-24 \times 1.2-3 \mu$. The paraphyses are characteristically corkscrew twisted at the tips.

47. *Lophodermium maculare* De-Not.

On *Vaccinium ovatum*, Siltcoos Lake, Lane County. February. Infrequent. No. 2233.

Not previously reported west of the Atlantic states.

48. *Lophodermium rhododendri* Ces.

On stems of *Rhododendron californicum*, Alsea Mt., and Blue River. March to June. Frequent. No. 2340; Epling No. 673.

This species is usually reported on leaves. No leaf infections were found. The infected areas on living stems were strikingly white with the distinct, black perithecia dotting them.

49. *Lophodermium pinastri* (Schr.) Chev.

On *Libocedrus decurrens*, Blue River. March. Epling and Shorett No. 591.

Family 7. STICTIDACEAE

50. *Stictis radiata* (L.) Pers.

On dead stems of *Rhus diversiloba*, Blue River. March. (Epling, 592.) No. 2309.

Family 8. DERMATIACEAE

51. DERMATEA CERASI (Pers.) Fries.

On sweet cherry, Corvallis. March. No. 2517.

Pycnidia of the imperfect stage are also present.

Family 9. MOLLISIACEAE

52. PYRENOPEZIZA RUBI (Fries) Rehm.

On *Rubus leucodermis*, Corvallis. February. No. 2489.

Our collection exhibits spores measuring $7.5-9 \times 1.3-2.5 \mu$ in asci measuring $32-40 \times 6-7 \mu$. This plant may be nearest to variety *tenerior* described from Italy but without material for comparison I refer it as above.

Family 10. HELOTIACEAE

53. CHLOROSPENIUM AERUGINOSUM (Oeder) De-Not.

On oak, Corvallis. April. Frequent. No. 2287.

54. PEZIZELLA LYTHRI (Desm.) Shear & Dodge.

On *Rubus*, Corvallis. November. Frequent. No. 2390.

This material was identified by Dr. B. O. Dodge, and is represented by the pycnidial stage (*Sclerotiopsis*) and the sporodochial stage (*Hainesia*). These stages are frequently found growing saprophytically on the stems and petioles of wild and cultivated species of *Rubus* in this state.

55. CIBORIA CAUCUS (Rebent.) Fuckel.

On aments of *Populus* and *Salix*, Benton County. April.

This fungus collected by Dr. H. M. Gilkey appears very similar to some of the *Sclerotinia* species but the apothecia are not produced from sclerotia. The spores are $8-10 \times 5-6 \mu$ and the asci measure $124-128 \times 8 \mu$.

56. DASYSYPHA AGASSIZII (Berk. & Curt.) Sacc. var. *rufipes* Phill.

On *Pinus monticola*, Hood River. July. No. 2359, and on *Pinus attenuata*, Corvallis. February. No. 6799. Infrequent.

57. LACHNELLA RUFO-OLIVACEA (Alb. & Schw.) Sacc.

On dead blackberry canes, Corvallis. March. No. 2516.

This disco is on the older canes usually clustered at the base of the buds.

Family 11. PEZIZACEAE

58. OTIDEA ONOTICA Fuckel.

In fir woods, Corvallis, November. No. 2384.

59. HUMARIA MACROSPORA Wallr.

On ploughed land, Corvallis. March. No. 2631.

60. HUMARIA SACCARDOI Cavares.

On burned-over soil, Corvallis. April. No. 2572.

61. *Acetabula murina* n. sp.

Cup 2-5 cm. broad, cup-shaped to expanded; *hymenium* mouse gray, drying deep neutral gray to slate color; *outside* lighter, neutral gray drying grayish olive, smooth to slightly radiate sulcate; *stipe* 3-6 cm. long, 5-8 mm. in diameter, costate lacunose, whitish with grayish tints, drying drab to lighter; *asci* cylindrical hyaline, not blue with iodine, 8-spored, $300-340 \times 12-14 \mu$; *spores* ellipsoid with one large vacuole, $17-20.5 \times 11-13 \mu$, smooth, hyaline; *paraphyses* hyaline, slender with straight clavate tip, septate.

In gardens, Corvallis. April. No. 6821, 6942. Collected by Dr. Helen M. Gilkey.

This species seems to have its nearest affinities with *A. Barlae* Bond. It differs in characters of the stipe, paraphyses, and size and shape of spores. It is called "murina" because of the mouse-color of the cup.

62. ACETABULA VULGARIS (Pers.) Fuckel.

In leaf mold in dense woods, Corvallis. March. No. 2561, 6819.

63. GALACTINIA PROTEANA (Boud.) Sacc. & Sydow, var. *sparasoides* Boudier.

Under conifers, Corvallis. April. Infrequent. No. 2368.

Also reported from southern Oregon by Prof. E. R. Lake.

64. PEZIZA STEVENSONIANA Ellis.

On ground in fir woods, Corvallis. April. No. 2560.

The spores in this collection measure $15-16 \times 8-9 \mu$, and they are smooth and hyaline. Since the spores are smaller I believe the collection is perhaps more correctly referred here than under *P. repanda*.

65. PEZIZA VESICULOSA Bull.

In rich or manured soil, Corvallis. January to June. No. 2622.

66. PEZIZA PRAETERVISA Bres.

On burned-over soil, Corvallis. February. Frequently found. No. 6874.

This species is close to *P. violacea* Pers. but differs in its larger size, asperulate spores and hooked paraphyses. The spores are $12-14 \times 6-7.5 \mu$, usually appearing smooth but becoming slightly asperate at maturity. Apothecia are 2.5-7 cm. broad and striking in color, the hymenium "blackish brown (1)" becoming "deep brownish drab" (Ridgway), the exterior slightly lighter with violaceous shades.

67. LACHNEA SCUTELLATA (L.) Gill.

On rotten apple wood, Corvallis. April. Common. No. 2341.

Family 12. HELVELLACEAE

68. MORCHELLA CONICA Pers.

In lawns, Corvallis. April. Frequent. No. 6818.

Sporophores up to 12 cm. tall. The spores are $19-21 \times 12-14 \mu$.

69. MORCHELLA ELATA Fries.

Fructification large, $24-28 \times 9-14$ cm.; *ascoma* conical, $12-14$ cm. \times $9-14$ cm., hollow, of 2 distinct layers, covered by a deep lacunose hymenial tissue with principal ribs longitudinal, netted between with very large lacunae having secondary labyrinthine folds extending to the fundamental cap tissue within, to a maximum depth of 4 cm., tawny olive becoming snuff brown or darker on aging; *asci* cylindrical to clavate, hyaline, not blue with iodine, $15-23 \times 200-320 \mu$, 8-spored; *paraphyses* clavate, $8-15 \times 140-250 \mu$, septate below, terminating in a longer cell about $100 \times 12-16 \mu$; *spores* hyaline, smooth, $17-20 \times 12-14 \mu$; *stipe* subequal to tapering, somewhat crinkled, $12-15 \times 3-7$ cm., hollow; cavity continuous with the cavity of ascoma; *surface of stipe* glabrous to pruinose-squamulose above, cream-colored to slightly darker; *stipe tissues* of two layers, the outer 2-3 mm. thick, extending above into the ascogenous tissue of the ascoma, the inner more rapid growing and becoming crinkled to cerebriform, even filling the basal portion of the cavity at maturity, extending upward into the ascoma where it becomes perforate or continuous.

Along fence rows in the open, Corvallis. April. Infrequent. No. 6810, 6878.

This species is very striking because of its size and stateliness. Massee has reported plants up to 25 cm. high.

70. *MORCHELLA PUNCTIPES* Peck.

On rich ground, Corvallis. April. Frequent. No. 2651.

This species belongs to the group *Pileatae*, the ascoma being free about half way up. The photograph (TEXT FIG. 3) illustrates the small conical points which adorn the stem. The whole plant reaches a maximum height of 12 cm. The ascoma is buck-

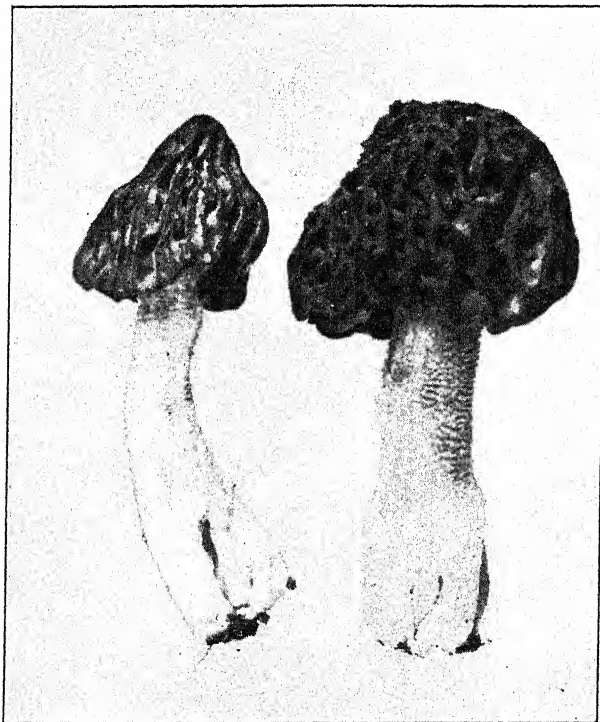


FIG. 3. *Morchella punctipes* Peck

thorn brown to mummy brown when fresh, drying lighter; stem is translucent cream buff to honey yellow, drying dirty white to drab. *Asci* cylindric, $220-280 \times 17-20 \mu$; *spores* ellipsoid, hyaline, light buff to warm buff in mass, $20-25 \times 14-16 \mu$. The only difference noticed in the Oregon collections is the furfura-

ceous character of the inner surface of the stipe. Peck described it as glabrous.

71. *MORCHELLA RIMOSIPES* DC.

In open woods, Chapman. April. Infrequent. No. 6817.

Our plant agrees in every respect except the free cap. In ours *only* the margin of the ascoma is slightly free.

Family 13. EXOASCACEAE

72. *Exoascus Pruni-subcordatae* n. sp.

Mycelium evidently perennial; *asci* clavate, often truncate, sometimes narrowed above, 8-spored, $54-61 \times 10-13 \mu$; *stalk cells* emergent, not wedged between cells of host, $12-16 \times 5-11 \mu$; *spores* ellipsoid to ovate, hyaline, often forming conidia in the *asci*, $6-10 \times 3.5-5 \mu$ (TEXT FIG. 4).

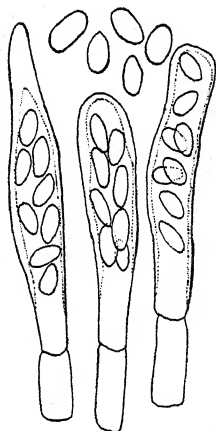


FIG. 4. Asci and ascospores of *Exoascus Pruni-subcordatae* Zeller.

On immature fruits of the Sierra Plum (*Prunus subcordata*) causing plum pockets, Douglas County, Oregon, and Santa Cruz Mts., California. May to June. No. 1084, 6925, 6924.

Wherever this disease of the wild plum occurs it is rarely possible to find healthy fruits. Dr. W. L. Jepson who collected it in California (6924) says concerning the specimens: "The enclosed are 'blasted' fruits of *Prunus subcordata* from the Santa Cruz Mts. During many years of botanizing in the Coast Ranges I have never found a mature sound fruit of this species, though such

are common in northeastern California. These Coast Range developments are whitish, bladdery, that is, thin-walled and hollow, 2 to 5 times larger than the dried up samples." The normal mature fruits of *P. subcordata* are $\frac{3}{4}$ to 1 in. long while many of the plum pockets of immature fruits are upwards of two inches long, usually about 1.5 inches long and variously creased and lobed. The diseased flesh is white and pithy, the surface being whitish and mealy.

Exoascus Pruni-subcordatae is much like *E. longipes* Atk. and *E. communis* Sad. in the shape of the stalk cells but differs in the much larger spores than these species and in its specialized host infection. As stated before,³ *E. Pruni-subcordatae* seemingly does not infect cultivated varieties of *Prunus* growing nearby the infected wild host.

³ Zeller, S. M. A "plum pocket" on *Prunus subcordata* in Oregon. Phytopath. 12: 443. 1922. (Abstract.)

OREGON AGRICULTURAL COLLEGE,
CORVALLIS, OREGON

A MYCOLOGICAL SURVEY OF PORTO RICO AND THE VIRGIN ISLANDS

H. M. FITZPATRICK

[A REVIEW]

During the Spanish occupation of Porto Rico practically no attention was given to the rich fungous flora of the island. Only two collections of fungi were made, and they were small and relatively unimportant. After Porto Rico was annexed by the United States the Insular Department of Agriculture undertook various mycological investigations and incidentally initiated a fungous survey. Between 1900 and the present a number of American botanists, interested in collecting, have visited the island, and several native Porto Rican botanists with training in taxonomic mycology have coöperated with them. In the aggregate a very considerable number of fungi have been collected, and distinct contributions toward a knowledge of various groups have been made. The fungi of Porto Rico are known now probably better than those of any other area of equal size in the American tropics.

The mycological survey of Porto Rico and the Virgin Islands which recently has been published by Seaver and Chardon¹ is a compilation based chiefly on previously published papers, and constitutes an annotated check-list of the known fungi of these Islands. The fungi of the Virgin Islands have been less extensively studied than those of Porto Rico, and are known chiefly from Seaver's collections made in 1923. The survey on the whole is surprisingly complete, and the paper will be of great service to all students of tropical fungi. The material is arranged on the basis of the classification of the fungi, the genera of a

¹ FRED J. SEAVER AND CARLOS E. CHARDON (with contributions by *Rafael A. Toro*; *F. D. Kern* and *H. H. Whetzel*; and *L. O. Overholts*). **Botany of Porto Rico and the Virgin Islands: Mycology**, in *Scientific Survey of Porto Rico and the Virgin Islands* 8¹: 1-208. 1926. [Published by New York Academy of Sciences.]

family and the species of a genus being listed in alphabetical order. Citations to the places of original publication are given, hosts are listed, and some indication of geographical distribution is attempted. The minimum of synonymy is included. A number of new species and a few new genera are described, full diagnoses being given in every case. The portion of the text covering the higher Basidiomycetes was prepared by L. O. Overholts, that on the rusts and smuts by F. D. Kern and H. H. Whetzel, while R. A. Toro has collaborated on several groups of the Pyrenomycetes and is responsible for the pages on the Pseudoperisporiales. Several other workers have contributed diagnoses of new species in their special groups. In the preface an historical sketch is given of the various activities which led up to the publication of the survey. Generic and host indices are appended.

A critical examination of the pages of the survey reveals certain points worthy of special mention. The scope of the survey includes the Myxomycetes and Schizomycetes as well as the fungi proper. In the first group 41 species are listed, while only 13 species of bacteria are mentioned. In the Phycomycetes a total of only 20 species is given. Only two of these are chytrids. The Ancylistales, Saprolegniales, and Monoblepharidales are unrepresented. The total number of Zygomycetes is seven. In the Ascomycetes there are no subterranean Tuberales or Plectascales, no Laboulbeniales, no Helvellaceae, one species of *Cordyceps*, only two of the Geoglossaceae, one of the Chaetomiaceae and relatively few Pezizales. In the Basidiomycetes fleshy forms are uncommon, there being 4 species of *Clavaria*, 4 of *Hydnum*, few Agaricaceae, and no Hymenogastrales. The rusts are well represented, there being 71 species of *Puccinia* alone. The parasitic fungi imperfecti and Pyrenomycetes occupy a prominent position. There are 65 species of *Cercospora*, 46 of *Phyllachora*, 84 of *Meliola* and 38 of *Asterina*. The Thelephoraceae and Polyporaceae are relatively abundant. It seems likely that knowledge of some of the poorly represented groups will be greatly increased when special emphasis is placed on their collection.

The following new genera, new species, new names, and new combinations occur. In the case of each new combination the older binomial is indicated in brackets.

Aspergillaceae.

- CERATOCARPIA WRIGHTII (Berk. & Curt.) Toro, comb. nov.
[*Perisporium Wrightii* Berk. & Curt.].

Microthyriaceae.

- ASTERINA SPATHULATA (Ryan) Seaver & Toro, nom. nov.
[*Asterina Miconiae* Ryan].
ECHIDNODES MICROSPORA (Chardon) Seaver & Toro, comb. nov.
[*Lembosia microspora* Chardon].

Hemisphaeriaceae.

- ASTERIDIPELLINA PORTORICENSIS (Speg.) Seaver & Toro, comb. nov.
[*Asteridium portoricense* Speg.].
ASTERIDIPELLINA Seaver & Toro, nom. nov. [*Asteridium* Speg.].

Erysiphaceae.

- ERYSIPHE MALACHRAE Seaver, sp. nov.

Perisporiaceae.

- APPENDICULELLA COMPOSITARUM PORTORICENSIS (Stevens) Seaver & Toro, comb. nov. [*Meliola compositarum* var. *portoricensis* Stevens].
IRENE SEMINATA (Berk. & Curt.) Seaver & Toro, comb. nov. [*Meliola seminata* Berk. & Curt.].
PERISPORINA PORTORICENSIS (Stevens) Seaver & Toro, comb. nov. [*Perisporium portoricense* Stevens].
PHAEODIMERIELLA CAYAPONIAE (Garman) Seaver & Toro, comb. nov. [*Dimerium Cayaponiae* Garman].

Capnodiaceae.

- PHAEOSACCARDINULA TENUIS (Earle) Seaver & Toro, comb. nov. [*Antennularia ? tenuis* Earle].
TRICHOETHYRIUM LOMATOPHORUM (Ellis & Ev.) Toro, sp. nov. [*Asteridium lomatophorum* Ellis & Ev. (in herb.)].

Pseudoperisporiaceae.

- POROSTIGME MICROSPORA Toro, sp. nov.
PSEUDOPERISPORIUM Toro, gen. nov.
PSEUDOPERISPORIUM ERIGERONICOLA (Stevens) Toro, comb. nov. [*Dimeriella erigeronicola* Stevens].

Nectriaceae.

- CALONECTRIA IGNOTA Chardon, sp. nov.
CREONECTRIA LAURENTIANA (Marchal) Seaver & Chardon,
comb. nov. [*Nectria Laurentiana* Marchal].
CREONECTRIA RUBROSULPHUREA Seaver, sp. nov.
CREONECTRIA MACROSPORA Chardon, sp. nov.
MACBRIDELLA CINNABARINA Seaver, sp. nov.
NECTRIA ANANATIS Seaver & Chardon, sp. nov.
NECTRIA CONFLUENS Seaver, sp. nov.
OPHIONECTRIA PALICOUREAE Seaver & Whetzel, sp. nov.
SPHAEROSTILBE MAMMIFORMIS Chardon, sp. nov.
THYRONECTRIA MEGALOSPORA (Speg.) Seaver & Chardon, comb.
nov. [*Pleonectria megalospora* Speg.].

Phyllachoraceae.

- ENDODOTHELLA TETRASPORA C. R. Orton, sp. nov.
PHYLLACHORA CHARDONI C. R. Orton, sp. nov.
PHYLLACHORA MASSINII Toro, sp. nov.
PHYLLACHORA SMILACICOLA Chardon, sp. nov.
PHYLLACHORA VIEQUESSENSIS C. R. Orton & Toro, sp. nov.
TRABUTIA ZANTHOXYLII Chardon, sp. nov.
TRABUTIELLA ICHNANTHI (Speg.) Seaver & Chardon, comb.
nov. [*Puiggarina Ichnanthi* Speg.].

Clypeosphaeriaceae.

- CLYPEOTRABUTIA Seaver & Chardon, gen. nov.
CLYPEOTRABUTIA PORTORICENSIS (Stevens) Seaver & Chardon,
comb. nov. [*Trabutia portoricensis* Stevens].

Mycosphaerellaceae.

- MYCOSPHAERELLA SACCHARI (Speg.) Seaver & Chardon, comb.
nov. [*Sphaerella Sacchari* Speg.].
MYCOSPHAERELLA TETRASPORA Seaver, sp. nov.

Xylariaceae.

- HYPOXYLON CITRINUM Shear, sp. nov.
HYPOXYLON LEUCODERMIIUM Shear, sp. nov.
PORONIA CHARDONIANA Toro, sp. nov.

Helotiaceae.

- DASYSCYPHA DICRANOPTERIDIS Seaver & Whetzel, sp. nov.

Hysteriaceae.

OSTREIONELLA Seaver, gen. nov.

OSTREIONELLA FUSISPORA Seaver, sp. nov.

Stilbaceae.

ARTHROBOTRYUM PENICILLATUM (Lév.) Seaver & Chardon,
comb. nov. [*Meliola* ? *penicillatum* Lév.].

PODOSPORIUM EFFUSUM Pat., sp. nov.

PODOSPORIUM PALLIDUM Pat., sp. nov.

Tuberculariaceae.

PUCCINIOPSIS CARICAE (Speg.) Seaver, comb. nov. [*Cerco-
spora* ? *Caricae* Speg.].

Tremellaceae.

TREMELLA PALLIDA Overholts, sp. nov.

TREMELLA INDURATA Overholts, sp. nov.

Hydnaceae.

HYDNUM URSINUM Lloyd, sp. nov.

Boletaceae.

BOLETUS EARLEI (Murrill) Overholts, comb. nov. [*Gyroporus
Earlei* Murrill].

Polyporaceae.

FOMES PORTORICENSIS Overholts, sp. nov.

POLYPORUS ACULEIFERA (Berk. & Curt.) Overholts, comb. nov.
[*Trametes aculeifera* Berk. & Curt.].

POLYPORUS ARGILLACEUS (Murrill) Overholts, comb. nov.
[*Ganoderma argillaceum* Murrill].

POLYPORUS BRITTONII (Murrill) Overholts, comb. nov.
[*Amauroderma Brittonii* Murrill].

POLYPORUS FULVOCINEREUS (Murrill) Overholts, comb. nov.
[*Corioloopsis fulvocinerea* Murrill].

POLYPORUS MAXIMUS (Mont.) Overholts, comb. nov. [*Irpex
maximus* Mont.].

POLYPORUS NITIDUS (Murrill) Overholts, comb. nov. [*Gano-
derma nitidum* Murrill].

POLYPORUS OCHROTINCTELLUS (Murrill) Overholts, comb. nov.
[*Coriolus ochrotinctellus* Murrill].

POLYPORUS PALLIDOFULVELLUS (Murrill) Overholts, comb. nov.
[*Coriolus pallidofulvellus* Murrill].

POLYPORUS PULVERULENTUS (Murrill) Overholts, comb. nov.
[*Ganoderma pulverulentum* Murrill].

POLYPORUS SUBGLABRESCENS (Murrill) Overholts, comb. nov.
[*Coriopsis subglabrescens* Murrill].

POLYPORUS SUBINCRUSTATUS (Murrill) Overholts, comb. nov.
[*Ganoderma subincrustatum* Murrill].

POLYPORUS TAYLORI (Murrill) Overholts, comb. nov. [*Coriopsis Taylora* Murrill].

TRAMETES CIRRIFER (Berk. & Curt.) Overholts, comb. nov.
[*Polyporus cirriferus* B. & C.].

Agaricaceae.

LENTINUS ECHINULATUS (Murrill) Overholts, comb. nov.
[*Crinipellis echinulata* Murrill].

OMPHALIA EUSPEIREA (Berk. & Curt.) Overholts, comb. nov.
[*Agaricus (Mycena) euspeireus* Berk. & Curt.].

Nidulariaceae.

CYATHUS COSTATUS Lloyd, sp. nov.

CYATHUS FIMICOLA Lloyd, sp. nov.

Lycoperdaceae.

LYCOGALOPSIS SUBICULOSUM Lloyd, sp. nov.

LYCOPERDON FIMICOLA Lloyd, sp. nov.

NOTES AND BRIEF ARTICLES

A CORRECTION

In a recent paper pertaining to the morphological characters of some Sphaeropsidales, Archer¹ has described the development of the acervulus-like pycnidia of *Hendersonia Rubi* (West.) Sacc. and has discussed the relationship between this species and certain species of *Coryneum*. He has based this study on the development of the pycnidia in pure cultures and the study of the organisms on the host under natural conditions. Archer finds that in the young stages of perithecial development "the entire cavity is lined with fungous tissue and conidiophores, there being less tissue above than below but nearer the time of maturity there is found only a basal palisade-like layer of conidiophores arising from a rather thin layer of hyaline pseudoparenchyma. . . . In this condition the structure is recognized as a *Coryneum*. Quite frequently, even on the same cane, another type of fruit body is found which seemingly occurs where the cuticle or epidermis has become loosened and where there is no tension to be overcome by the hyphae which constitute the developing primordium. This structure, readily recognized as a pycnidium, tends to be globose, with definite pseudoparenchymatous tissue." Archer has also called attention to the complete agreement between the herbarium material and cultures of *Hendersonia Rubi* which he has had opportunity to examine and the original description of *Coryneum ruborum* Oud. together with the additional description and illustrations by myself.² Previously to the publication of my paper referred to, I had observed only the acervulus-like fruiting body as suggested by Archer, but after reading Archer's paper it has been my privilege to study a collection of *Hendersonia Rubi* collected by Archer in Michigan and the European collections in

¹ Archer, W. A. Morphological characters of some Sphaeropsidales in culture, with reference to classification. *Ann. Myc.* 24: 1-84, *pl.* 1-8, *fig.* 1-8, 1926. (See pp. 46-51.)

² Zeller, S. M. *Coryneum ruborum* Oud. and its ascogenous stage. *Mycologia* 17: 33-41, *pl.* 3, *text fig.* 1. 1925.

Sydow, *Mycotheca germanica* 1701 and 1702. I now agree fully with Archer that the western collections upon which I had based my identification of *Coryneum ruborum* in Oregon are identical with the European *Hendersonia Rubi*.

Under these circumstances the ascospore stage described by the writer should be given Westendorp's specific name and the new combination should be *Ascospora Rubi* (Westend.) Zeller, comb. nov.

This thus identifies with the Pacific coast another typical European plant disease. In Europe this disease does considerable damage to plants of the genus *Rubus*. In England, according to Leaflet No. 269 of the Board of Agriculture and Fisheries, "*Hendersonia Rubi* Westendorp is responsible for most of the injury caused to raspberries and loganberries," where it is controlled by a spray of bordeaux mixture applied during the summer and by the usual sanitary methods. In Oregon I have applied the common name, *Ascospora cane spot*, for this disease.

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MYCOPHAGIC NOTES

THE YELLOW-GILLED RUSSULA

During the summer, when most species of *Russula* are fruiting, insects are so abundant and the plants so scattered that the mycophagist cannot depend very much upon them for his table. But I have found the yellow-gilled species very satisfactory, both in Virginia and northern Florida, for several reasons. It appears in the fall when the cool weather keeps the insects in check; it grows gregariously and appears abundantly in the open pine woods, coming up under the masses of needles, sometimes half a dozen or more together; and all parts of the hymenophore, including the tender, fleshy stem, are edible.

During the latter part of October, it was abundant about Lynchburg, Virginia, while at Gainesville, Florida, I collected it frequently toward the end of November and later for my table.

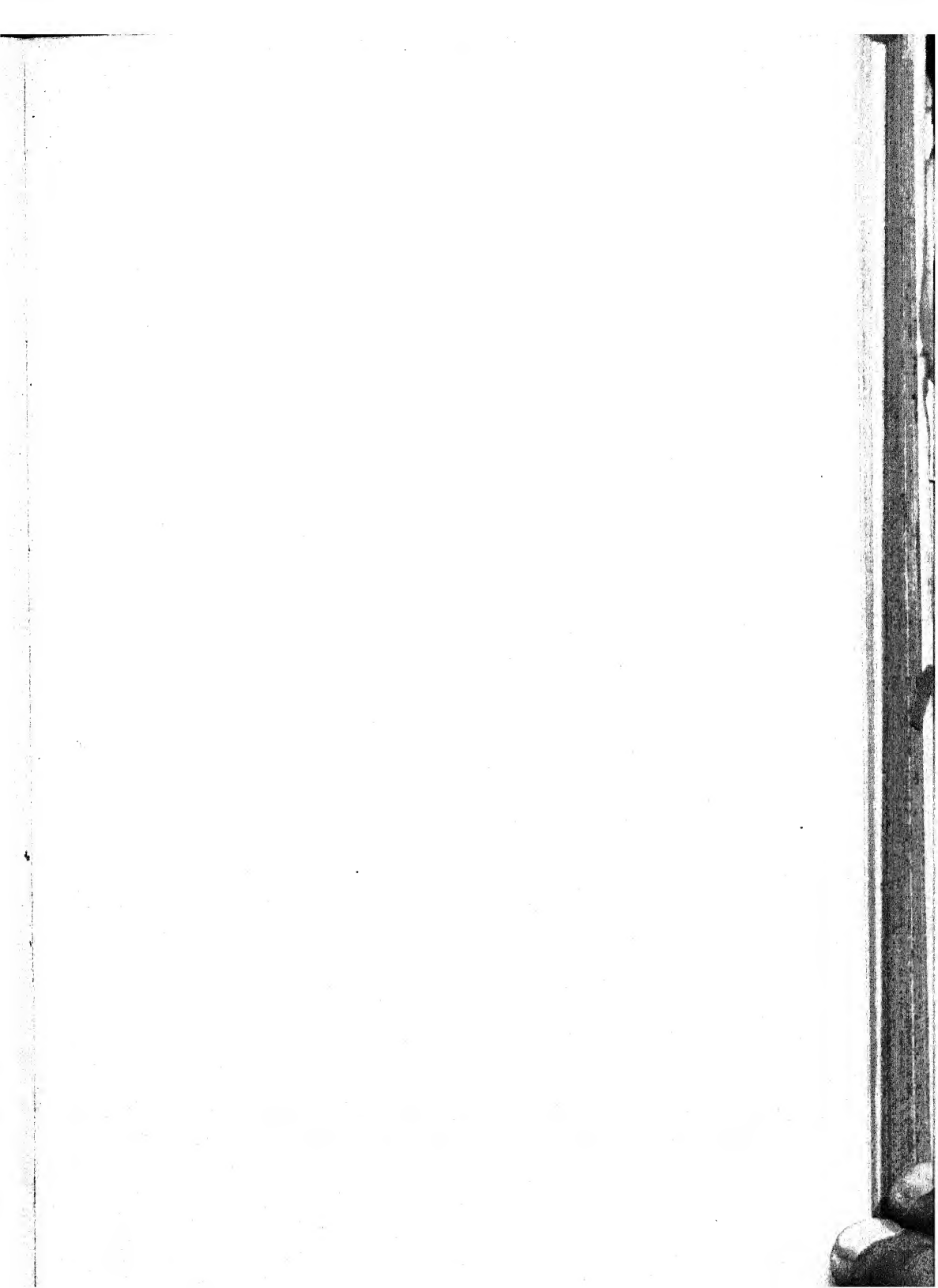
The species is a pretty one and readily recognized among the red species of the genus by its distinctly yellow gills. When very young they are white like those of *R. emetica*, but they very soon become yellow and there is no reason to confuse the two species.

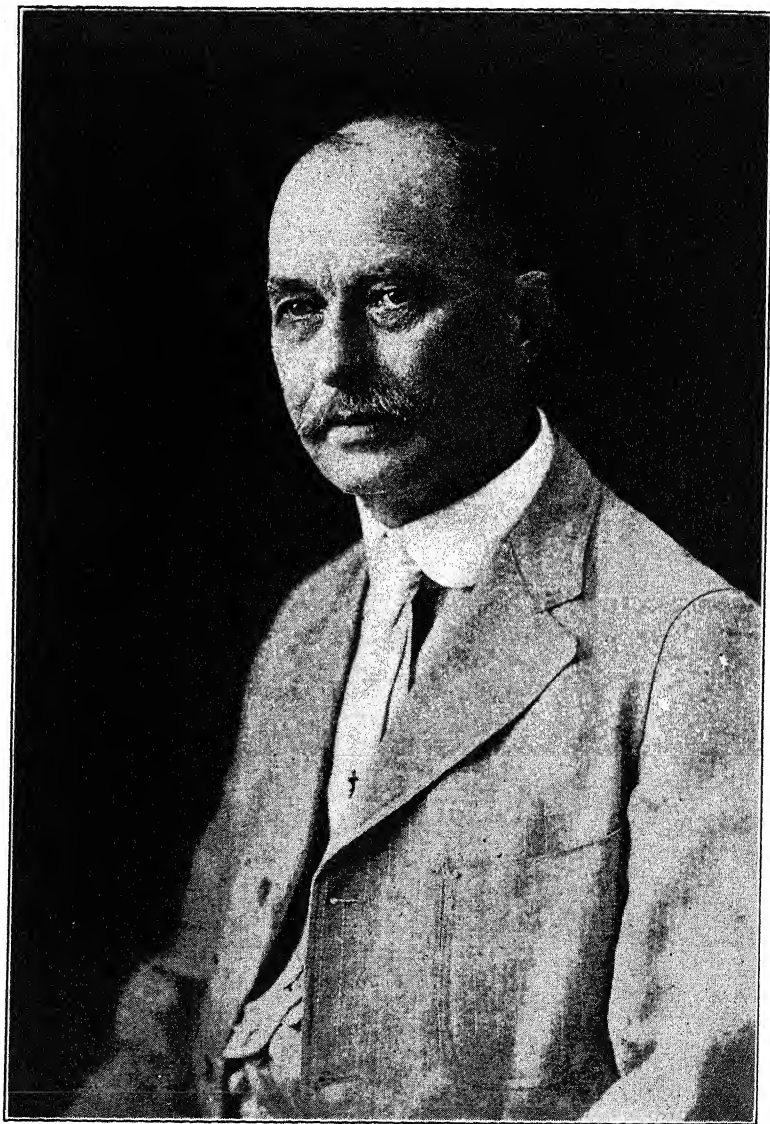
In cooking the yellow-gilled *Russula*, I simply cut off the base of the stem; wash off adhering bits of dirt and trash; cut into halves or quarters according to size; and boil in a little water with salt for five or ten minutes until thoroughly soft. Evaporated milk and a dash of black pepper make excellent seasoning. Serve on buttered toast.

The autumn in Florida was quite dry and few fleshy fungi were found in November. On November 27, however, I collected enough for a mess by mixing *Pluteus cervinus*, *Lactaria Indigo*, *Laccaria laccata*, *Hygrophorus miniatus*, a species of *Helwella*, and the yellow-gilled *Russula*. On the following day, I found a quantity of the last species in a little pine grove and used it alone. The squirrels here are very fond of this species.

W. A. MURRILL

GAINESVILLE, FLORIDA,
November 29, 1926





CURTIS G. LLOYD

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CURTIS GATES LLOYD

H. M. FITZPATRICK

(WITH PLATE 12)

In the passing of C. G. Lloyd, American mycology has lost one of its distinctive personalities. Recognized as the world's outstanding authority on the Gastromycetes, he was indeed an international figure. His numerous publications, privately printed and freely distributed, made his name familiar to correspondents in every country and clime, while the humorous digressions and biting satires which enliven his pages have long constituted a distinct source of entertainment for the mycological public. In the limited compass of this sketch it is impossible to give more than an abbreviated account of his life and work, but emphasis will be placed on some of the more striking aspects of his unique individuality.

During the last year of his life Mr. Lloyd was stricken with rapidly failing eyesight, and several months before his death was forced to abandon entirely his mycological studies. In June, he received the honorary degree of Doctor of Science from the University of Cincinnati in recognition of his contributions to mycology. He died November 11, 1926, in Bethesda Hospital in Cincinnati, Ohio, at the age of sixty-seven.

He was born at Florence, Kentucky, July 17, 1859. His father taught in a country school there. When Lloyd was nine years old the family moved to Crittenden, Kentucky. Such schooling as he had was obtained in the country schools. He never attended any institution of higher education. When a young man he went to Cincinnati to make his own way, and

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obtained employment there as an apprentice and bottle-washer in a retail drug store. He must have given himself wholeheartedly to the task of learning the drug business, for at the age of 25 he formed, with his two older brothers, John Uri Lloyd and Nelson Ashley Lloyd, the firm of Lloyd Brothers. The firm prospered and soon became one of the best known wholesale pharmaceutical houses of the Middle West. In 1918, Mr. Lloyd retired from the firm with a considerable fortune, and at his death left an estate valued in excess of \$750,000.

From boyhood Lloyd had been keenly interested in flowers, and he took up early as a hobby the study of taxonomic botany. He had already acquired a personal herbarium of the flowering plants of the eastern United States when, through contact with Professor A. P. Morgan, he was influenced to transfer his attention to the fungi.

Morgan, on account of failing health, had retired to a small farm near Preston, Ohio, not far from Cincinnati. Lloyd became acquainted with him and visited him frequently there. Morgan's interest in Gastromycetes was imparted to Lloyd, and Lloyd has paid tribute to him in one of his papers.¹

About 1905 Lloyd made an arrangement with his brothers, whereby he placed a man in charge of his department in the firm, and retired from active participation in the business. He then gave himself completely to the study of mycology. He soon recognized that to do the most critical work he must see the authentic specimens in the older herbaria of Europe, and he spent much of his time during a period of nearly fifteen years in study abroad. He travelled extensively and browsed about in all of the important museums of the old world. Early in life he had begun the accumulation of books on botany, and this became an obsession with him. He spent much time in the book centers of Europe, purchasing everything that dealt with plants. With his brothers he founded the Lloyd Library in Cincinnati, which has grown to be one of the largest libraries devoted primarily to botany. He provided second-hand dealers with a complete list of the volumes already in the library, and instructed them to furnish anything else that came to hand.

¹ Mycol. Notes 31. 1908.

The library is especially complete on *materia medica* and mycology and contains over fifty thousand volumes.

The Bulletin of the Lloyd Library, published by Mr. Lloyd, consists of 26 numbers. Six of these were written by him on mycological subjects, while the others are chiefly reproductions of rare old prints or papers on pharmacy and entomology. Mr. Lloyd's best known persona' publication, *Mycological Notes*, appeared in 75 numbers over a period of 28 years. He published also various special monographs, circulars and letters. His complete works, when bound with the indices provided by him, comprise seven volumes. His contribution to a knowledge of the genera and species of the *Gastromycetes* and certain other groups of the larger fungi will be conceded to be an important one. His papers contain a wealth of information, and are illustrated by hundreds of original photographs. His treatment of groups from the point of view of the world as a whole makes his papers especially valuable. It is to be regretted only that the fragmentary data scattered through his pages were not later reassembled in more usable form. His papers contain much interesting information concerning the foreign museums and herbaria, as well as valuable side-lights on mycologists past and present. The biographical sketches of American and foreign students of the fungi which appeared in connection with a series of portraits published in *Mycological Notes* is one of his outstanding contributions, and of interest to all mycologists.

His publications, distributed gratis to a large mailing list, were always accompanied by the request for specimens of fungi of the groups in which he was chiefly interested. He welcomed all material, whether common or rare, preserved everything, and never tired of naming unidentified collections for correspondents. He received thousands of specimens from collectors in every country of the world. His herbarium is housed in Cincinnati near the Lloyd Library in a separate building named the Lloyd Museum. He published the statement that it "contains ten times as many of the larger fungi as all the other museums of the world combined." The specimens are not arranged in the orthodox fashion. The museum walls resemble those of a shoe-store where boxes of uniform size stand exposed on shelves.

These boxes, when opened, usually reveal many smaller boxes within. Common species are represented by large numbers of specimens, revealing in many cases world-wide distribution. Mr. Lloyd was often able to demonstrate in such an assemblage of specimens intergrading variations revealing the identity of supposedly different species described from widely separated regions. The herbarium is distinctly a personal one and lacks the standard sets of exsiccati so prominent in many others. It is especially rich in Gastromycetes, Polyporaceae, Thelephoraceae, subterranean Ascomycetes, and the larger Pyrenomycetes such as *Xylaria*, *Hypoxylon*, *Hypocrea* and *Hypomyces*. It contains relatively few microscopic or parasitic forms. Mr. Lloyd avoided the use of the microscope in as far as possible. Since he preferred to study only fungi which can be examined satisfactorily in the dry state he gave the Agaricaceae little attention.

At his death he left almost his entire estate to endow the library and museum. They were placed in trust years before to insure their perpetual maintenance. He desired that they "remain free to the public for the benefit of science." It is to be hoped that adequate provision has been made for their proper care.

Mr. Lloyd never married. While in Cincinnati he maintained bachelor's quarters in the museum. So much of his time was spent abroad that he found it desirable to have a European address. He had a permanent office in England and employed a secretary to care for the specimens that came to him there. In later years he spent much of his time during the summer on his country estate in Kentucky. He owned a fine farm of nearly 400 acres containing much virgin timber near Crittenden. He beautified the place by planting roses in mass along the highway, and transplanted to his land the rare native plants of the region. At his death he left the farm as a wild life preserve.

Mr. Lloyd did not attend the annual meetings of his fellow mycologists and botanists, and to many he was not personally known. The writer first met him when he came to Ithaca, in 1919, to examine the larger Pyrenomycetes in the Atkinson herbarium. Mr. Lloyd was much impressed by the natural

beauty of Ithaca, and more especially by the richness of the fungous flora. We spent a pleasant week collecting² with him, and after he had gone we learned that he had quietly and without ostentation purchased one of our favorite collecting grounds, an 80 acre tract of cold upland sphagnum bogs surrounded by wooded hills near McLean, N. Y. It was thus preserved against grazing and logging operations, and having been fenced and provided with a little laboratory building it affords an ideal opportunity for field work in various phases of biology.³ It is called the Lloyd-Cornell Reservation. Later, Mr. Lloyd purchased 436 acres of wild land nearby, at Slaterville Springs, designating it as a wild-flower preserve, and shortly before his death added a third, a pot-hole region in beech woods at Ringwood Hollow.⁴ Thus three of the favorite collecting grounds at Cornell were preserved for future generations of students. All of these reservations were placed by Mr. Lloyd in trust, under the local management of a member of the biology staff of the Cornell faculty. He will long be regarded by local botanists as one of our most liberal benefactors.

To the botanical world at large Mr. Lloyd was best known perhaps for his amusing tirades against the prevailing convention of citing authors' names after the generic and specific names of plants. He refused to follow the practice in his own writings and believed sincerely that it is an unnecessary and reprehensible one leading to too hasty publication and unwarranted multiplication of so-called species. From the fact that he published privately he was enabled to make his criticisms distinctly personal, and woe to the mycologist who became the subject of his attack. The most outstanding contribution of this type which came from his pen was *The Myths of Mycology*, published in 1917. In it he says, "the mistakes, blunders, and personal foibles of mycological writers have been my chief source of pleasure. I have never failed to express myself plainly, and have spared neither friend nor antagonist. I have always tried to be good-natured in my comments, and as a general thing the

² Mycol. Notes 61, Pl. 137, fig. 1574. 1919.

³ Bulletin 27 of the Lloyd Library. 1926.

⁴ Mycol. Notes 74: 1346 and Science 64: 570.

parties affected are taking it more as a joke on themselves and an idiosyncrasy of myself. . . . Nor am I deceiving myself into the belief that I will accomplish what I am apparently trying to bring about, the abolition of personal advertisements in mycology."

In the recent numbers of *Mycological Notes*, Mr. Lloyd called attention to the paragraphs in which he ridiculed the work of others by printing alongside of each a cut of a little grinning Chinese idol. This idol was erected by him⁵ to the god Tso Kay, guardian of "priority pedantry, Kuntzeism, and other irregular practices in mycology." The broad grin on the face of the little graven image is in a very true sense emblematic of Mr. Lloyd's attitude toward much of the work that has been published on taxonomic mycology.

Some years ago Mr. Lloyd facetiously presented to his readers as real a wholly imaginary mycologist, Professor McGinty,⁶ who was much given to searching through ancient tomes for forgotten information concerning the fungi. From time to time there appeared in *Mycological Notes* remarkable "new genera," "new species," and "new combinations" attributed to McGinty. It was with the greatest satisfaction that their real author realized later that certain foreign workers were giving these forms serious consideration.

Mr. Lloyd prided himself on his eccentricity. Four years before his death he erected a monument to himself in the cemetery at Crittenden, Kentucky. He said it was intended as "a burlesque on tombstones in general" and a satire on mycologists who have passed "the Osler age." It bears the inscription on the following page.

And now that he lies beneath the stone his friends will realize that he would desire from them no higher tribute than to be remembered with a smile.

⁵ *Mycol. Notes* 72: 1300; 73: 1323.

⁶ Letter No. 48, p. 12. 1913.

CURTIS G. LLOYD

MONUMENT ERECTED IN 1922 BY
HIMSELF FOR HIMSELF DURING HIS
LIFE TO GRATIFY HIS OWN VANITY

WHAT FOOLS THESE MORTALS BE!

NOTE ON MYXOTHECA HYPOCREOIDES AND ITS SYNONYMY

ROLAND THAXTER

(WITH 2 TEXT FIGURES)

In a letter received from Dr. Farlow during a stay of some months in the island of Trinidad, B. W. I., during the winter of 1912-13, he asked me to be on the lookout for a very curious fungus reported by Ferdinandsen and Winge to have been found by H. Lassen, a member of Professor Warming's Expedition to Venezuela, etc., in 1891-92, growing in the Maraval Valley, near Port of Spain, on the fronds of *Trichomanes pinnatum*, and named by them *Myxotheca hypocreoides* nov. gen. et sp. On a first visit to this valley, which is traversed by a partly shaded brook, and, though unduly civilized, proved a rich locality for fungi, the form in question was readily found in abundance not only on *Trichomanes*, but on the fronds of various other ferns, as well as the leaves and even stems of a variety of flowering plants, both woody and herbaceous. Further investigation also showed that it was by no means confined to this locality, but occurred abundantly in various other parts of the island.

As may be seen from the accompanying photograph, very kindly made for me by Professor Weston from dried material, it is conspicuous from its contrasting white color, and occurs in the form of discrete, cushion-like masses, associated in variable numbers on a thin whitish subiculum, which may often have a very distinctly yellowish green tint, that persists, even after prolonged desiccation, in herbarium material. Such a subiculum or thallus is clearly indicated in Figure 1, which represents a specimen found on the leaves of a huge sedge, growing in woods about the Aripo Savanna, near Cumuto.

The cushion-like masses, which suggest in appearance the egg-masses of some minute spider, are flattened and somewhat

uneven above, brittle and friable from the presence of a whitish granular substance which is apparently excreted by the very



FIG. 1. General habit, on large sedge. Natural size. Trinidad material.

slender branching hyphae. With care, the thin cushions may be lifted intact from the substratum, surrounded by a fringe of the subiculum. When examined under a low power, abundant and irregular loosely branching filaments of some trentepohliaceous alga are usually conspicuous in this fringe, while the cushion itself, in favorable material, is occupied by variable numbers of large, thick-walled asci, sometimes as many as forty or fifty, immersed, discrete and irregularly distributed in a single layer, the algal element being absent or having been destroyed in this region.

The younger asci are more deeply immersed in the matrix of the cushion and are furnished with gelatinous walls of very great thickness. They arise, much like the spores of *Glaziella*, terminally from stout hyphae which lose themselves in the compacted elements of the cushion, although they are described, by the authors mentioned, as radiating from a common center, as if they originated from some definite archicarp. The present writer has been unable, however, to trace them to such an origin. As the ascus develops, it gradually presses outward the surrounding matrix of granules and fine disorganized hyphae, which become compacted to form a more or less definite envelope about it. The mature ascus is not emergent above the somewhat irregular surface of the stroma, which is formed by branching and anastomosing "paraphyses," quite undifferentiated, except by the numerous minute, short, blunt branchlets at their tips; and it seems probable that, when moisture is absorbed, owing to the swelling of the gelatinous ascus-wall and of the surrounding elements of the stroma, the ripe spores are forcibly ejected.

A method of this sort would further explain the minute pits which, like pin pricks, dot the surface of older cushions. The large spores are nearly colorless, usually eight in number, but occasionally less, oblong fusiform, slightly curved, with rounded ends, the concave margin slightly prominent in the mid-region, and are dictyosporic; the transverse divisions fifteen, or somewhat variable in number, more or less discontinuous and irregular; the loculi in each transverse row one to five, and more or less irregular in size and relative position, their contents coarsely granular.

It being evident from the presence of abundant and characteristic gonidia that the plant was one of the innumerable leaf-lichens which so often contend with hepatics to cover coriaceous leaves in moist shady situations in the tropics, it was sent, with other miscellaneous lichens collected in Trinidad, to Dr. Vainio, whose report on the small collection submitted to him has been published in the Proc. Am. Acad. Arts & Sci. (58: 131-147. Ja 1923). In this paper the species under consideration is referred to the lichen-genus *Arthonia* (Arthothelium) and treated as a variety *hypocreoides* (Ferd. & Winge) Vain. of *A. candida* (Krempelh.) Vain., one of the many interesting forms discovered by Beccari in Borneo, and originally described by Krempelhuber as *Myriostigma candidum* nov. gen. et sp. in a privately printed paper entitled "Lichenes foliicolae" (1874), and later republished in the Nuov. Giorn. Bot. Ital. (7: 45. 1875). Although the white cushions, or stromata (apothecia), are two to four times as large in Beccari's plant, it appears to correspond very closely to the West Indian form, and the generic name used by Krempelhuber was suggested by the presence, in older specimens, of the numerous minute pits "quasi acu facta" above referred to, and regarded by him, for some reason which is not evident, as being apothecia. In both papers a second species, *M. cardinale*, found on bamboo in India, is referred to, but not described, although two spores are figured in the second paper. Some years later J. Müller-Argau, who had examined the original Beccari specimens, in his Lichenolog. Beitr. (Flora 73: 194, 1890), remarks of Krempelhuber's type of *Myriostigma* "est vera Arthothelii species et dein *Arth. candidum* Müll.-Arg. nominandum est,"

also stating that it is nearly allied to *A. leucocarpum*, a corticolous form described by him in Proc. Roy. Soc. Edinb., Session 1881-82, p. 468, from material collected by Balfour in the Island of Socotra, northwest of Africa.

There are thus three forms to which that described by Ferdinandsen & Winge is closely related, but there seems some doubt as to its absolute identity with either. Whether a careful comparison of all four would show essential differences is uncertain; but it may be remarked that the somewhat peculiar shape of the spores of the West Indian type, owing to their curvature and the rather characteristic median enlargement on

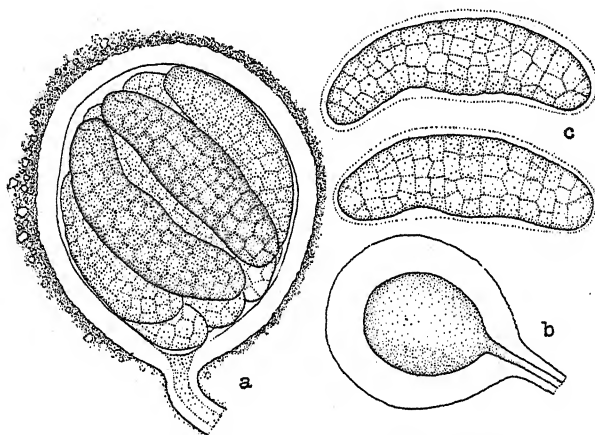


FIG. 2. *a*, Ascus from type of *Ascomycetella filicina* Ellis & Ev. *b*, young ascus from same showing thick wall. *c*, two spores from Trinidad material.

the concave side, is not mentioned in the other descriptions; and the gross dimensions of the apothecia in the Bornean form, to which it is referred by Vainio as a variety, are from two to four times greater. In view of the latter circumstance, Vainio remarks, in the paper cited, that "forsan est autonoma species."

In looking over proof for the new edition of the Farlow & Seymour Host Index which is being prepared by Mr. Seymour at the Farlow Herbarium, the writer was struck by the fact that the Jamaican *Ascomycetella filicina* Ellis & Ev. was listed under *Trichomanes*, and reference to the original description, in Jour. Inst. Jamaica (1: 247. Ap 1893), seemed to indicate that the forms described on the same host by Ferdinandsen

and Winge and by Ellis were identical. This supposition was confirmed by the examination of a fragment of the original specimen from the Ellis Herbarium, very kindly sent me by Dr. Seaver, one of the asci from which is herewith illustrated in Figure 2, *a*. It may further be mentioned here that a form identical in all respects with that from the West Indies was found by Dr. Linder on his recent expedition to British Guiana.

If, as seems not improbable to the writer, the suggestion of Vainio is correct and the American form proves to be distinct from either of the related species above mentioned, the specific name used by Ellis would of course have priority. The determination of this point, however, should be left to European lichenologists who have access to the original specimens. It is evident, however, from what has been said, that *Arthonia candida* var. *hypocreoides* (Ferd. & Winge) Vainio, *Myxotheca hypocreoides* Ferd. & Winge and *Ascomycetella flicina* Ellis & Ev. are synonymous.

FARLOW HERBARIUM,
HARVARD UNIVERSITY

NOTE

Since the above was in type Professor Zahlbruckner has very kindly sent me a specimen of the original gathering by Beccari of Krempelhuber's *Myriostigma candidum*, which, although differing in its much greater size and more conspicuous and copiously developed grey-green thallus, seems identical in its microscopic characters with the West Indian form.

CULTURAL LIFE HISTORIES OF DIAPORTHE. II¹

LEWIS E. WEHMEYER

(WITH PLATES 13-15)

The life histories of the following species of *Diaporthe* present additional evidence for the fact, previously mentioned by the writer (21 & 22), that the species of this genus possessing a *Phomopsis* type of imperfect stage have certain correlated characters in the perithecial fruit body. These species have two-celled hyaline ascospores and, in most cases, have a differentiated entostromatic area which is more or less completely circumscribed by blackened zones within the substratum. Of the following species, the only one (*Diaporthe decedens* (Fries) Fuckel) which does not show such a blackened zone under natural conditions produced marginal lines in culture, showing that even this species has the potentiality of forming such zones.

DIAPORTHE MEGALOSPORA

This species was described by Ellis (6, 235) from Manchester, Mass., on *Sambucus canadensis* L. The material used as a source of the following cultures was collected at Waverly, Mass., on the same host, and agrees perfectly with Ellis' description.

The fungus is often scarcely visible on the surface of the twigs. In some cases the ostioles are erumpent as numerous, short, conical to cylindrical, spine-like projections; in other cases the ostioles fail to break through the periderm and grow along laterally beneath this tissue for some distance; again, under moist conditions, the ostioles may be larger and much elongated (1-3 mm.). The entostroma is effuse. The surface of the wood is blackened, forming a dorsal bounding zone. The bark tissues are mostly disintegrated. The dorsal blackened zone

¹ The work reported in this paper was carried out at Harvard University under the grant of a National Research Fellowship in the Biological Sciences.

rarely extends into the disintegrated bark, except where pycnidial stromata are formed, where it extends upward over the surface of these. Ordinarily, there is no darkened ventral zone present. At the lateral margins of the entostromatic areas a blackened zone extends 1-2 mm. into the wood, and there is often a greenish discoloration of the wood outside these areas (PLATE 13, FIG. 5), but no definite bounding line. The perithecia are spherical or somewhat flattened; they are $400-575 \times 320-400 \mu$, and buried in the wood. The asci (PLATE 14, FIG. 3) are clavate, have a refractive ring in the apex, and measure $65-90 \times 11-15 \mu$. The spores (PLATE 14, FIG. 4) are biserial in the ascus, cylindrical-fusoid, 2-celled, hyaline, constricted at the septum, usually somewhat curved or inequilateral, and $24-39 \times 3.5-5.5 \mu$.

A suspension of ascospores of *Diaporthe megalospora* Ellis & Ev. was sprayed onto agar on Sept. 20, 1925. Twenty-four hours later these spores were germinating by means of a single germ tube $2-3 \mu$ in diameter. The spores did not swell upon germination.

On October 15, pycnidia were found in single spore cultures on Leonian's agar. These pycnidial stromata originated as superficial knots of intertwined hyphae. In the first stromata formed, conidial formation was initiated very early, while in the succeeding formations the stromata reached a much larger size before conidial cavities arose. As a result the pycnidia varied from 85 to 550 μ in diameter.

The origin of the pycnidial cavity and the production of conidia begins over a more or less irregularly flattened zone within the pycnidial stroma, or sometimes at several different points within the same stroma. The first indication of the formation of such a conidial cavity is the appearance of a zone of active, deeply staining cells, richly filled with protoplasm. These cells elongate radially and may have comparatively heavy walls like the neighboring stromatic hyphae. The conidial locule originates as the result of a plane of cleavage within this area of meristematic cells. Within this cleavage area the walls of the cells are dissolved or gelatinized and the protoplasts grow out as active conidia producing cells or conidiophores (PLATE 14, FIG. 2), which are $2.5-3.5 \mu$ in diameter. The first

conidia formed are of the filiform hamate type. They arise as small bud-like outgrowths of the above-mentioned cells, and grow out to the mature cylindrical form. The alpha conidia are formed later as the swollen tips of more or less elongated sterigma-like outgrowths of the conidiophore cells (PLATE 14, FIG. 2). This formation of an area of meristematic cells and its cleavage to form conidiophore cells progresses laterally until, for one or another physiological reason, the cells with a dense and active protoplasmic content fail to be formed at the margins. Since the outer layers of the stroma soon become inactive and form a protective coat, the progress of this cleavage, especially if it starts in the upper layers of the stroma, is liable to be somewhat parallel to the surface and form a hollow-hemispherical cavity, giving the dome-shaped basal protrusion so common in the form genus *Phomopsis*. As rapid conidial production continues the conidiophore cells are used up. As long as they are physiologically capable of doing so, the subhymenial layers of cells become meristematic and take over the function of conidia formation. In this manner the cavity increases in size until it encroaches upon an area of inactive cells. In the smaller, first formed pycnidia the locules are comparatively large and regular in shape, and the stromatic wall is very thin, due to the comparative lack of differentiated outer layers of inactive cells. In the larger, later formed stromata the locules are liable to be comparatively small, flattened and irregular in outline, and the stromatic wall is apt to be much thickened on account of the greater formation of inactive tissue before the initiation of cavity formation.

There were also formed in this culture large blackened stromatic masses within the agar. Sections through these stromata showed that they corresponded to the entostroma formed on stems. The interior of these bodies consisted of a rich growth of fine hyaline hyphae within the agar substratum. These hyphae took a deeper stain with eosin than the ordinary vegetative hyphae outside these areas. These stromatic areas were sharply defined by a layer of large, closely interwoven, black walled hyphae, forming a peripheral crust. One or more superficial pycnidial stromata were often formed on the surface of

these entostromatic areas, and were then enclosed within a continuation of the outer cortical crust.

From the variations just cited, it can be seen that the size, shape and structure of the pycnidial stroma, pycnidial locule, and so-called pycnidial wall are by no means constant, and are very unreliable as diagnostic characters, at least in *Phomopsis* and related form genera.

When first examined, on October 15, the culture mentioned showed only the beta type of conidia. These were long cylindrical, hamate, hyaline, 1-celled, and $14-20 \times 1 \mu$ (PLATE 14, FIG. 6). On November 16, conidia of the alpha type were found in this same culture. The alpha conidia were elliptical to fusoid, hyaline, 1-celled, and measured $10-14 \times 3-6 \mu$ (PLATE 14, FIG. 5). The earlier spore horns, containing only the beta type of conidia, were whitish, while the later ones composed of the alpha conidia were a yellowish-brown in color.

On November 15, 1925, steam-sterilized stems of *Sambucus canadensis* L. were inoculated from a single spore culture. By January 10, 1926, these twig cultures showed numerous stout cylindrical, erumpent ostioles, 2-4 mm. in length. Irregular, pulvinate, stromatic masses were formed within the bark tissues by a proliferation of hyphae and a disintegration of the host cells in this area. When pycnidia are formed, they arise as spherical or irregular locules (PLATE 14, FIG. 1) within this tissue. Conidia of both types were formed on *Sambucus* stems. The alpha type were somewhat narrower than those produced on agar, measuring $10-15 \times 2.5-3.5 \mu$. The perithecia arose as small hyaline knots of hyphae, usually within the wood tissue. They were scattered singly and not definitely oriented beneath the stromata within the bark. These perithecial primordia, very early, gave rise to a massive perithecial neck with a diameter ($120-160 \mu$) often as great or greater than the primordium itself. These perithecial necks push and dissolve their way through the tissues, often growing laterally for some distance in order to reach one of the stromatic areas mentioned, through which they usually become erumpent. No mature ascospores were formed after four months in culture on *Sambucus* stems. A ventral blackened zone was seen on these stems, deep in the wood or within the pith.

Von Höhnelt (14, 118) states that *Diaporthe megalospora* is a *Melanconis* on account of the presence of band-like paraphyses. The writer (21) has pointed out elsewhere that the presence or absence of paraphyses is an unsatisfactory diagnostic character. The presence of a differentiated entostromatic area, marginal blackened zones and a *Phomopsis* stage in the life history shows conclusively that this is a typical *Diaporthe*.

DIAPORTHE PECKII

This species was described from *Rhus Toxicodendron* L. by Peck (17, 52) as *Diaporthe sparsa* Peck. This species name being occupied by the *D. sparsa* of Niessl. (1883), Saccardo (19, IX, 713) designated this species as *D. Peckii* Sacc. The type of *D. Peckii* (Herb. N. Y. Mus., Saugerties, 1885, by Peck) is identical with the material collected on *Rhus Vernix* at Whitmore Lake, Mich., and used as a source of the cultures studied.

This species appears on the surface of the stems as dirty gray erumpent discs, which are scarcely visible and contain 2-5 papillate ostioles; or as more noticeable circular perforations of the periderm; or again, as minute, separately erumpent, conical ostioles. The pycnidia often occur as numerous, minute, pustulate ruptures of the periderm. The entostroma is effuse. An indefinite dorsal blackened zone dips irregularly into the bark between the perithecia, and extends into the wood at the lateral margins of the entostromatic areas (PLATE 13, FIG. 1). There may, or may not, be a ventral blackened zone within the wood, bounding the lower margin of the entostromatic area. The perithecia are spherical, 300-600 μ in diameter, and are either scattered singly or clustered in small groups. They are usually collectively erumpent through a small stromatic disc, but may also, occasionally, be separately erumpent. The asci (PLATE 14, FIG. 8) are clavate, have a refractive ring in their tip and measure 65-85 \times 8-10 μ . The spores (PLATE 14, FIG. 9) are biserial in the ascus, elliptic-fusoid to cylindric-fusoid, usually curved, and often irregular in shape. They are 2-celled, hyaline, constricted at the septum and measure (18) 20-40 \times 3-5 μ .

Suspensions of ascospores were sprayed onto agar on October

7, 1925. These spores were largely immature, and only a few had germinated after twenty-four hours, but after forty-eight hours a number of spores had put out from one to three germ tubes, $3.5\ \mu$ in diameter.

After three to four weeks, single spore cultures on six per cent oat agar produced numerous, gray, spherical, pycnidial stromata, which often possessed a papillate to conical ostiole. These stromata were 0.5–1.5 mm. in diameter. The surface layers of hyphae are blackened to form an outer crust, and the pycnidial stromata are usually seated on an immersed stromatic area, which is bounded by a continuation of this blackened zone. This immersed stroma corresponds to the entostroma formed on stems, as mentioned under *D. megalospora*. There is a rich development of fine, hyaline, deeply staining hyphae within this area.

The pycnidial stromata usually contain a single conidial locule, which is variable in shape and surrounded by a zone of darkened hyphae. The conidiophores are long filiform and bear two types of conidia. The first type formed are the beta conidia (PLATE 14, FIG. 11), which are long filiform, hamate, hyaline, 1-celled and measure $16\text{--}23\ (28) \times 1.5\ \mu$. The alpha conidia are formed later by the swelling of the tips of the conidiophores, and are fusoid-elliptic, hyaline, 1-celled and measure $9\text{--}12\ (15) \times 2\text{--}2.5\ \mu$ (PLATE 14, FIG. 10).

Steam-sterilized stems of *Rhus Toxicodendron* L. and *Rhus Vernix* L., inoculated from single spore cultures, showed pycnidial stromata after three to four weeks. Perithecial initials were not seen until after nine weeks in culture. Numerous pulvinate, grayish to greenish stromata were formed within or beneath the periderm. The pycnidial stromata were composed of broad, upright, parallel, septate, dark colored hyphae, $3\text{--}5.5\ \mu$ in diameter. Within these stromata there were formed one or more irregularly shaped conidial locules. Each locule opened to the exterior through a definite beak-like ostiolar neck, which projected somewhat above the surface of the stroma (PLATE 14, FIG. 7). Conidia of both types were produced in these pycnidia. The fusoid alpha conidia measured $11\text{--}15 \times 2\text{--}2.5\ \mu$, and the hamate beta ones $16\text{--}18 \times 1\ \mu$. Spore horns composed of the

alpha conidia were pinkish in color, while those made up of beta conidia were greenish.

Definite entostromatic areas were formed on these stems. These areas were outlined, both dorsally and ventrally, by a zone of closely interwoven, dark walled hyphae forming a sclerotial layer. In these entostromatic areas, perithecial initials were formed beneath some of the stromatic discs. These stromata usually remained sterile and were not as well developed as the pycnidial stromata.

DIAPORTHE RHOINA

This species was first described as *Diatrype rhoina* Cooke & Ellis by Cooke (4) in 1878. Cooke gave the spores as 1- to 5-septate and $40 \times 4 \mu$. On the basis of these septate spores of Cooke, Saccardo (19, II, 234) placed the species in the genus *Calospora* as *C. rhoina*. Ellis (7, 424) later states that Cooke's measurements are incorrect and gives the spores of his *Diaporthe rhoina* (Cooke & Ellis) as uniseptate and $12-15 \times 2.5-3 \mu$. Ellis' original material of *Diatrype rhoina* (N. Am. Fungi 2d ser. 1953) shows such smaller spores measuring $12-15 \times 2.5-3 \mu$. His later exsiccati of *Diaporthe rhoina* (Fung. Columb. 1046a) and of *Calospora rhoina* (Fung. Columb. 511), however, are both specimens of *Diaporthe Peckii*. As the stromatic characters of *D. Peckii* and *D. rhoina* are at times very similar, it was thought probable that Cooke's original material might have been *D. Peckii*, as his spore measurements agree with that species. Through the kindness of the Royal Botanic Gardens at Kew, the writer was able to examine Cooke's original material. This, as well as two other collections sent by Ellis, all show the small fusoid ascospores, measuring $11-16 \times 2-3 \mu$, which leaves no doubt as to the identity of *Diaporthe rhoina* (Cooke & Ellis) Ellis, nor as to the incorrectness of the original spore measurements.

In 1901, there was issued in Fungi Columbiana (1528) a *Diaporthe confusa* Ellis & Ev. with the note "*Diaporthe rhoina* in N. Am. Pyr. and N. Am. Fungi 3433 and Fungi Columb. 1046." As already mentioned, Fungi Columb. 1046 is in reality *D. Peckii*, while N. Am. Fungi 3433 is issued as a forma *mahaleb*

of *D. rhoina*, on cherry. Fungi Columb. 1528 is the true *D. rhoina*, and *D. confusa*, therefore, is a synonym of this species.

In 1901, Feltgen (8, Nacht. II, 131) described a fungus on *Rhus Vernix* as *Gnomonia rhoina*. Rehm, in a letter to Feltgen, pointed out that this species possessed a black marginal zone and was in reality a *Diaporthe*. In 1903, Feltgen (8, Nacht. III, 145) published the species as *D. rhoina* Feltg. Later, in 1906, von Höhnelt (13, 1250) again pointed out that this was a *Diaporthe* and gave it as *D. rhoina* (Feltg.) Rehm. What is apparently a portion of Feltgen's original material, in von Höhnelt's herbarium (A4051, Jan. 21, 1900), shows numerous, small ($280-320 \times 80-160 \mu$), scattered perithecia within an effuse stroma, bounded by a definite ventral line within the wood. The spores of this specimen measure $13 \times 2-2.5 \mu$. It appears to be a form of *Diaporthe Eres* on *Rhus*, and must await a critical examination of this large group of related species for its final diagnosis.

Material of *Diaporthe rhoina* was collected on *Rhus Toxicodendron* L. near Quincy, Ill., and on *Rhus Vernix* at Waverly, Mass. The fungus appears upon the surface of the twigs as very slightly pustulate clusters of ostioles, barely erumpent through a minute yellowish or blackened stromatic disc, which crumbles away with age leaving a mere perforation of the periderm. The entostroma is effuse. There is a dorsal blackened zone on the surface of the bark; this zone dips irregularly into the bark between the perithecial groups. The entostromatic areas of the bark are usually light in color. The perithecia are spherical or somewhat flattened, $375-500 \times 275-350 \mu$, and are scattered singly or in small groups either in the bark or wood, but are usually collectively erumpent. On *Rhus Toxicodendron* the pustulate areas containing the perithecial groups are more strongly developed and often appear as isolated stromata. The dorsal blackened zone penetrates through the bark and obliquely into the wood at the margins of the fruiting areas, but very rarely continues beneath as a ventral bounding line (PLATE 13, FIG. 2). The asci (PLATE 14, FIG. 13) are clavate and measure $45-50 \times 8-9 \mu$. The spores (PLATE 15, FIG. 2) are biserial in the ascus, elliptic-fusoid, 2-celled, hyaline, constricted at the septum and measure (11) $12-15 \times 2.5-3$ (3.5) μ .

Suspensions of the ascospores from twigs of *Rhus Toxicodendron* were sprayed onto agar on November 15, 1925. After forty-eight hours, one free spore and all of the spores within one ascus had germinated. The spore had not swollen and produced 3 germ tubes 3-4 μ in diameter.

Cultures on oat agar, from the single spore, produced pycnidia, and entostromatic areas as described for *D. megalospora* and *D. Peckii*. There was formed a loose superficial mat of mycelium within which pycnidia arose. On the agar surface against the test tube walls, there were formed irregularly effused entostromatic areas outlined by a blackened, somewhat raised zone on the surface. In some cases this blackened zone merely penetrated slantingly into the agar for 1-2 mm., while in others it continued ventrally and completely enclosed areas within which there was a rich development of fine hyaline hyphae. Scattered throughout these entostromatic areas there were formed dark colored, erumpent-superficial stromatic discs. Many of these remained sterile, but others produced conidial locules in their interior. These locules contained only one type of conidium, which was long fusoid, 1-celled, hyaline and measured 13-15 \times 1.5-2.5 μ (PLATE 15, FIG. 1).

On March 10, and April 3, 1926, inoculations were made from the single spore culture onto stems of *Rhus Toxicodendron* and *R. Vernix* respectively. After two months, both of these cultures showed a number of grayish, pulvinate, slightly erumpent pycnidial stromata, but no signs of perithecia. The pycnidia (PLATE 14, FIG. 12) consisted of irregular stromatic masses, formed beneath the periderm or partially within the bark, and containing elliptical or irregularly shaped conidial locules, which were often incompletely surrounded by a zone of darkened hyphae. Conidia of the alpha type only were found in these locules.

On *Rhus Toxicodendron*, numerous, irregular, blackened zones were formed in the bark and often extended into the wood, but, as is characteristic of this species, these zones seldom completely outlined the enclosed areas ventrally. On *Rhus Vernix* these black zones were only occasionally seen, extending through the bark from the pycnidial stromata to, but not into, the wood.

DIAPORTHE DECEDENS

The synonymy of a number of species of *Diaporthe* on *Corylus* is interwoven with that of *Diaporthe decedens* (Fries) Fuckel. These relationships will be considered after looking at the life history of *D. decedens* itself.

Material of this species was collected on *Corylus americana* Walt. near Ann Arbor, Mich. When young, it appears on the surface as numerous, small, circular, pustulate, ectostromatic discs, 0.2–0.4 mm. in diameter. As the perithecia mature these discs fall away leaving circular perforations about which the papillate ostioles become separately erumpent through the surrounding periderm. These ostioles may also be scattered singly, as minute pustules, over the surface of the twig. There is no blackened zone in either the wood or the bark, and no true entostroma. The perithecia are spherical or flattened, $480\text{--}720 \times 320\text{--}480 \mu$; they are in loose clusters or scattered singly, but always separately erumpent (PLATE 13, FIG. 3). The asci (PLATE 15, FIG. 4) are clavate, with a refractive ring in the apex, and are $65\text{--}85 \times 10\text{--}15 \mu$. The spores (PLATE 15, FIG. 7) are elliptic-fusoid, 2-celled, hyaline, constricted at the septum, acute at the ends and variable in size. When young, the spores are $13\text{--}18 \times 3.5\text{--}4.5 \mu$, but when fully mature they are $14\text{--}22 \times 4\text{--}6 \mu$. Faint hyaline appendages are sometimes present on these spores, especially when immature, but these are not a constant character.

A suspension of ascospores from *Corylus* was sprayed onto agar on October 10, 1925. These ascospores measured $14\text{--}18 \times 5 \mu$, but were apparently immature as they failed to germinate. A few twigs were consequently placed in a damp chamber and allowed to remain there for four days. At the end of this time the spores measured $14\text{--}22 \times 5\text{--}5.5 \mu$, and some of the spores showed the evanescent appendages. Sprays of these ascospores germinated readily within twenty-four hours. A single germ tube was produced. This germ tube was narrow ($1.5\text{--}2 \mu$) at the point of emergence from the spore wall, but rapidly increased to a diameter of $4.5\text{--}5 \mu$.

Single spore cultures on oat agar produced a superficial mycelial mat within which were formed numerous spherical

pycnidial stromata, 400–600 μ in diameter. Many of these stromata remained sterile, but others produced a central, irregular to spherical cavity in a manner similar to that described for *D. megalospora*. The walls of the outer layers of hyphae of these stromata were thickened and blackened. Conidia of two extreme types, with many intermediate forms, were cut off from a hymenium of filiform conidiophores lining the locule. One type of conidium (PLATE 15, FIG. 5) was elliptic-fusoid to elongate-fusoid, straight, hyaline, 1-celled, and $11-15 \times 2-2.5 \mu$. The second type of conidium (PLATE 15, FIG. 6) was narrower, cylindrical, hyaline, 1-celled, usually somewhat curved and measured $8-13 (15) \times 1-1.5 (2) \mu$. There was a layer of large thick walled hyphae in the surface layers of the agar, but no blackened zones penetrated into the substratum as in the other species discussed.

On November 5, twigs of *Corylus americana* Walt. were inoculated from a single spore culture. Numerous erumpent-superficial, white stromata were formed on the moister portions of these twigs, and on February 9, 1926, both pycnidia and perithecia were found.

Small, scattered, conical ectostromata, 300–700 μ in diameter, were formed on the bark surface just beneath the periderm. The small, irregular or spherical conidial locules (PLATE 15, FIG. 3) were formed either in these ectostromata or in the entostromatic tissues of the bark beneath. Only the allantoid beta type of conidium was found on these twigs. The spore horns were yellow in color.

The perithecia formed were scattered, or in small groups throughout the bark, but were not oriented in any definite manner beneath the ectostromatic discs. The perithecial necks penetrated separately through the periderm itself and not through the stromatic discs, although they were often clustered beneath these discs. Mature asci and ascospores, which measured $12-18 \times 3-4.5 \mu$, were produced.

This species is given throughout the literature as lacking any blackened zone in the bark, and the writer has never seen any such zone in any material collected in the field. This lack of any dark colored zones and the presence of a *Phomopsis* type of imperfect stage seemed to make this species an exception to

the general rule that the species of *Diaporthe* possess both of these characters, as already pointed out. In culture, on *Corylus*, however, definite black zones were seen penetrating through the bark and into the wood at the lateral margins of what were, apparently, entostromatic areas (PLATE 15, FIG. 3). Only very rarely were these zones seen to continue horizontally. Here, then, we have a species which has the potentiality of producing such blackened marginal zones but practically never does so under ordinary conditions. This fact together with the scattered, separately erumpent character of the perithecia and the numerous intergrading forms of conidia formed in agar cultures might be considered as evidence pointing to this species as a primitive form of the genus.

This species was apparently first described by Persoon (18) as *Sphaeria decedens*, under *S. tessella*, and as differing from that species in the absence of any dark line. Fries (11, 49) described it as *Sphaeria decedens* Fries, stating that it had no distinct disc and that the perithecia were either solitary or gregarious and separately erumpent. Fries (10, 405) also described a *Sphaeria tessera* on *Corylus*, which he states is similar to *S. tessella* Pers., but with the perithecia aggregated and forming an erumpent cortical disc. In 1859, Berkeley and Broome (2, 364) described *Diatrype pyrrhocystis* on *Corylus*. Both the original description and the type collection of *D. pyrrhocystis* (Rab. Fung. Eur. 136) show that it has clustered perithecia with a slight development of entostromatic mycelium about them, resulting in a flat cortical disc as described by Fries for *S. tessera*. The perithecia of this species are smaller than those of *Diaporthe decedens*, and the spores are somewhat larger ($21-27 \times 6-8 \mu$), are more rounded at the ends, and are more constantly appendaged. In 1869, Fuckel (12, 204) described this species as *Diaporthe pyrrhocystis* (Berk. & Br.) Fuckel and stated that according to Nitschke it was synonymous with both *S. decedens* Fries and *S. tessera* Fries. In 1871, Fuckel (12, Nacht. I, 30) recalled this statement and erected two new species, *Diaporthe decedens* (Fries) Fuckel with appendaged spores measuring $12 \times 4 \mu$ and *Diaporthe tessera* (Fries) Fuckel with non-appendaged spores measuring $14-16 \mu$. The ascospores

of *D. decedens* are slow in maturing and show a range of spore measurements wider than those covered by Fuckel's two species. The effect of maturing in a damp chamber, already mentioned, and the examination of a large number of specimens shows this very clearly. The appendages on the spores are only occasionally present and are very evanescent. Fuckel's, two species are undoubtedly the same. The type material of *D. decedens* (*Dialytes decedens* (Fries) Nit., Fuckel, Fung. Rhen. 1983) in the Farlow Herbarium shows nothing but young ectostromata of this species as generally interpreted, which probably accounts for the small spore measurements of Fuckel. The type material of *Diaporthe tessera* (*Wuestneia tessera* Awd., Fuckel, Fung. Rhen. 592) is identical with the material of *D. decedens* collected and described by the writer. This type material also yielded curved conidia measuring $9-18 \times 1.5 \mu$, similar to those obtained in culture.

In 1918, von Höhnelt (14, 120) gave *D. tessera* as having small appendages and as transitional to *D. decedens*. He also gave *Diaporthe revellens* Nit., *D. tumulata* (Cooke & Ellis) Sacc. and *D. pusilla* Sacc. as synonyms of *D. decedens*. This synonymy is incorrect and apparently due to von Höhnelt's conception of *D. decedens*. The single specimen of *D. decedens* in von Höhnelt's herbarium was collected by W. Krieger and is *D. revellens*. Krieger's F. Sax 2468 of *D. decedens* is also *D. revellens*. *D. revellens* is probably the same as *D. Eres* Nit. as the ascus, ascospore and even conidia measurements are identical, and the stromatic configuration is the same. *D. revellens* is easily distinguished from *D. decedens* by the presence of a definite blackened ventral zone in the wood and the smaller ($9-13 \times 2.5-3.5 \mu$) spores. *Diaporthe tumulata*, according to the original description (3, 49) and an exsiccata of Ellis (Herb. N. Y. Mus., Ellis 2366) seems to be the same as *D. revellens*. *Diaporthe pusilla* Sacc. is also this same species. Saccardo (20, 289) says it resembles *D. revellens*, but differs in the smaller, more scattered perithecia. The type collection of *D. pusilla* (Petrak's Fl. Boh. & Mor. 978) and several other collections of Petrak's, in the Farlow Herbarium, show scattered perithecia buried within the wood, but of a size within the lower limits of those

of *D. revellens*. These specimens are identical to Petrak's exsiccati of *D. tumulata* (Fl. Boh. & Mor. 20) and to his forma *immersa* of *D. revellens* (Fl. Boh. & Mor. 1121). They merely represent a form of *D. revellens* on young twigs with thin bark.

From the preceding, therefore, three species emerge. First, *Diaporthe decedens* (Fries) Fuckel which is the *Sphaeria decedens* of Fries and the same as *Diaporthe tessera* of Fuckel. Secondly, *Diaporthe pyrrhocystis* (Berk. & Br.) Fuckel, which is the *Diatrype pyrrhocystis* of Berkeley and Broome and probably the *Sphaeria tessera* of Fries. And thirdly, *Diaporthe revellens* Nit., which is the same as *D. Eres* Nit. and has as synonyms *D. tumulata* (Cooke & Ellis) Sacc. and *D. pusilla* Sacc.

DIAPORTHE STRUMELLA

This species was first described by Fries (9, 101; 10, 365) as *Sphaeria strumella*. In 1846, he (Sum. Veg. Sc., 385) listed this species as *Diatrype strumella*. It was issued by Fuckel (Fung. Rhen. 598) as *Valsa strumella*, and was later placed by him (12, 205) in the genus *Diaporthe*. Winter (23, 654) gives *Sphaeria tentaculata* Batsch (1, 277) and *S. olivacea* Ehr. (5, 16) as probable synonyms. Fuckel's type of *Diaporthe strumella* (Fries) Fuckel (Fung. Rhen. 598) and nearly all other exsiccati examined by the writer agree with Fries' original material of *Sphaeria strumella* (Scler. Suec. 115) and constitute a distinct species. In 1867, Nitschke (16, 246) described *Diaporthe pungens* on *Ribes*. He states it differs from *D. strumella* in its effuse stroma, evenly scattered perithecia, shorter spores and elongated ostioles. Karsten (15, 113) made this species a variety of *D. strumella*. Of the three exsiccati of *D. pungens* seen by the writer, one (Roum. Fung. Gall. 3531) contained only a dothideaceous fungus, while the other two (Syd. Myc. March. 2055 and Pet. Fl. Boh. & Mor. 35) were typical of *D. strumella* with definitely clustered perithecia and spores of the same size. Sydow's exsiccati have elongated ostioles, but this is a variable character and occurred constantly in culture.¹ Von Höhnelt (13, 1255) gives *Diaporthe*

¹ Nitschke's type material of *D. pungens* has since been examined. It is *D. spiculosa* (Alb. & Schw.) Nit., and not *D. strumella* (Fries) Fuckel. The spores are shorter ($11-12 \times 2.5-3 \mu$) than *D. strumella*, and there is no strongly developed ectostromatic disc.

spireaecola Feltg. as a synonym of *D. strumella*. Feltgen (8, Nacht. III, 147) gives the host of his species as *Spiraea* sp., but his material in von Höhnelt's herbarium is labelled as being *Ribes* and is typical of *D. strumella*.

Material of *Diaporthe strumella* was collected on *Ribes* sp. near Ann Arbor, Mich. The stromatic configuration of this species is quite variable. Superficially the stromata appear as minute pustulate clusters of short cylindrical ostioles, or as small, laterally elongated, elliptical discs, 0.5–1 mm. in diameter, with the ostioles scattered over the surface of the disc. The perithecia are spherical or somewhat flattened and 300–400 μ in diameter. They are usually grouped in small clusters beneath a definite cylindrical or conical stromatic disc, but are occasionally more or less scattered. The perithecia lie in a slightly differentiated entostromatic area of the bark. In some cases each group of perithecia lies in an isolated entostromatic area of the bark and is bounded by a dark zone; in other cases the entostromatic areas of the bark are confluent or effuse (PLATE 13, FIG. 4). In either case these entostromatic bark areas are seated on an effuse entostroma within the wood, outlined by a ventral blackened zone deep in the wood, often bordering on the pith. In some cases this ventral zone in the wood is absent or only occasionally visible, due to the fact that the entire woody tissue is entostromatic in nature. The asci (PLATE 15, FIG. 9) are clavate and measure $35\text{--}45 \times 7\text{--}9 \mu$. The spores (PLATE 15, FIG. 10) are biseriate in the ascus, fusoid elliptical, 2-celled, hyaline, constricted at the septum and characteristically inequilateral or slightly curved. The spores measure $13\text{--}16 \times 2.5\text{--}3.5 \mu$.

Suspensions of ascospores sprayed onto agar on December 11, 1924, were germinating twenty-four hours later. The germinating spores were not swollen and produced a single germ tube $2.5\text{--}3 \mu$ in diameter.

Single ascus cultures on oat agar, when examined six months later, showed both pycnidia and perithecia. Numerous pulvinate stromata were formed within and upon a superficial mat of mycelium on the surface of the agar. The surface layers of these stromata were composed of a zone of blackened hyphae

which continued into the agar ventrally beneath the fruiting areas, delimiting an entostromatic area beneath the pycnidia. The pycnidial locules were irregular in shape and were bounded by a darkened wall-like zone of hyphae. Conidia of only one type were found on agar. These were the fusoid-elliptic, 1-celled, hyaline, alpha conidia (PLATE 15, FIG. 12) which measured $6-8 \times 2.5 \mu$. The perithecia were formed immersed in the entostromatic areas of the agar. They were usually abnormal in their development but mature ascospores were found in a number of them.

Single spore cultures on sterilized twigs of *Physocarpus opulifolius* (L.) Maxim. produced perithecial stromata but no pycnidia. Later single ascus cultures on *Ribes* sp. made on November 9, 1925, produced both perithecia and pycnidia.

Numerous cylindrical stromatic discs were formed on twigs as a result of a rapid proliferation of mycelium in the upper bark layers. These stromata reach a diameter of $500-1000 \mu$, and occasionally (on *Ribes*) contain one or more small, irregularly shaped, conidial locules, $100-400 \mu$ in diameter. In these pycnidia on *Ribes* a second type of conidium (PLATE 15, FIG. 11) was found. These conidia were long cylindric-fusoid, usually straight or slightly curved, 1-celled, hyaline and measured $11-15 \times 1.5 \mu$.

Numerous perithecia were formed on these twigs, usually in clusters beneath the stromatic discs, through which they were erumpent as fascicles of elongated thread-like ostioles, about 1 mm. in length. The blackened marginal zones were distinct in both the wood and the bark, but were often irregularly disposed due to the excessive stromatic development in culture. Clusters of perithecia were actually developed completely immersed within the pith, as well as in superficial stromatic masses. Normal stromata were also formed, and mature ascospores which were characteristically inequilateral and measured $10-13 \times 2.5-3.5 \mu$ were produced in abundance.

SUMMARY

1. The conidial stage has been obtained from ascospore cultures of *Diaporthe megalospora* Ellis & Ev., *D. Peckii* Sacc.,

D. rhoina (Cooke & Ellis) Ellis, *D. decedens* (Fries) Fuckel and *D. strumella* (Fries) Fuckel.

2. The imperfect stage was of the *Phomopsis* type in each case, although only the alpha type of conidium was produced in the case of *D. rhoina*. The beta type of conidium was hamate, filiform in *D. megalospora* and *D. Peckii*, and cylindric to cylindric-fusoid, slightly curved or allantoid in *D. decedens* and *D. strumella*.

3. Cultures from single ascospores gave rise to perithecia with mature ascospores in the case of *D. decedens* and *D. strumella*, and to immature perithecia in the case of *D. megalospora* and *D. Peckii*.

4. *D. decedens*, the only species not showing blackened marginal zones in the substratum under natural conditions, produced such zones in culture, on twigs of *Corylus*, indicating a primitive condition.

5. The formation of the conidial locule in *D. megalospora* is described.

6. A discussion of the synonymy of each species is given.

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EXPLANATION OF PLATES

PLATE 13

Fig. 1. Vertical section through entostroma of *Diaporthe Peckii* Sacc. on twigs of *Rhus Vernix* L.

Fig. 2. Vertical section through entostroma of *Diaporthe rhoina* (Cooke & Ellis) Ellis on twigs of *Rhus Vernix* L.

Fig. 3. Vertical section through pustules of *Diaporthe decedens* (Fries) Fuckel on twigs of *Corylus americana* Walt.

Fig. 4. Vertical section through stromata of *Diaporthe strumella* (Fries) Fuckel on twigs of *Ribes* sp.

Fig. 5. Vertical section through entostroma of *Diaporthe megalospora* Ellis & Ev. on *Sambucus canadensis* L.

PLATE 14

Diaporthe megalospora Ellis & Ev.

Fig. 1. Vertical section through pycnidial fruit body as formed in culture on *Sambucus canadensis* L.

Fig. 2. Vertical section through lateral margin of young pycnidial locule showing method of cavity formation.

Fig. 3. Ascus with ascospores.

Fig. 4. Ascospores.

Fig. 5. Alpha type of conidia produced in culture.

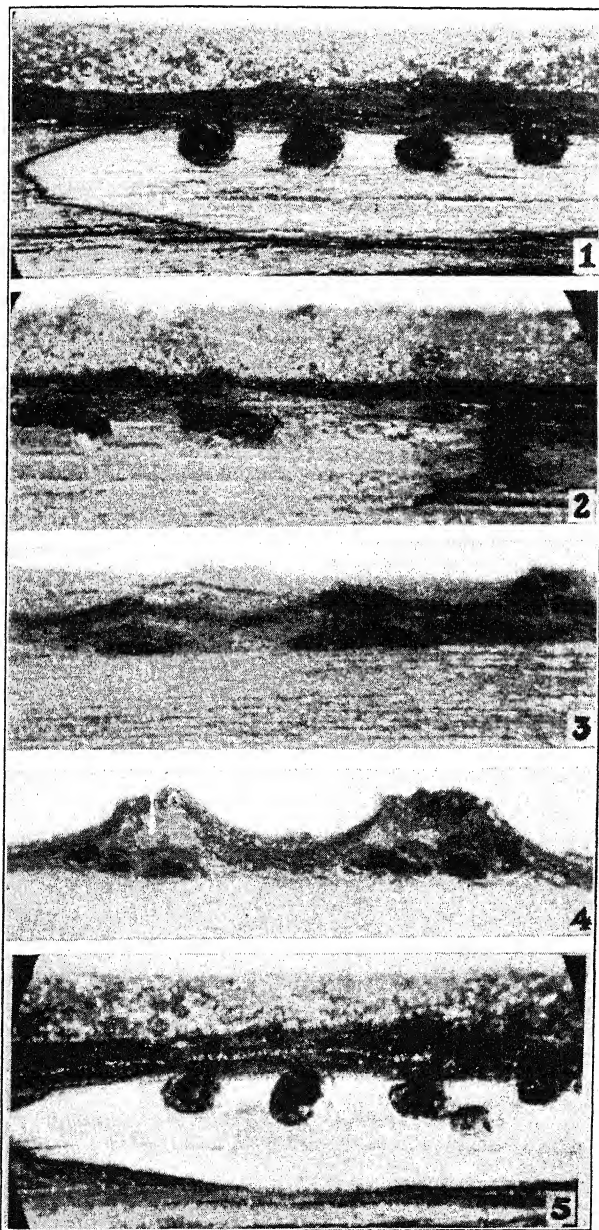
Fig. 6. Beta type of conidia produced in culture.

Diaporthe Peckii Sacc.

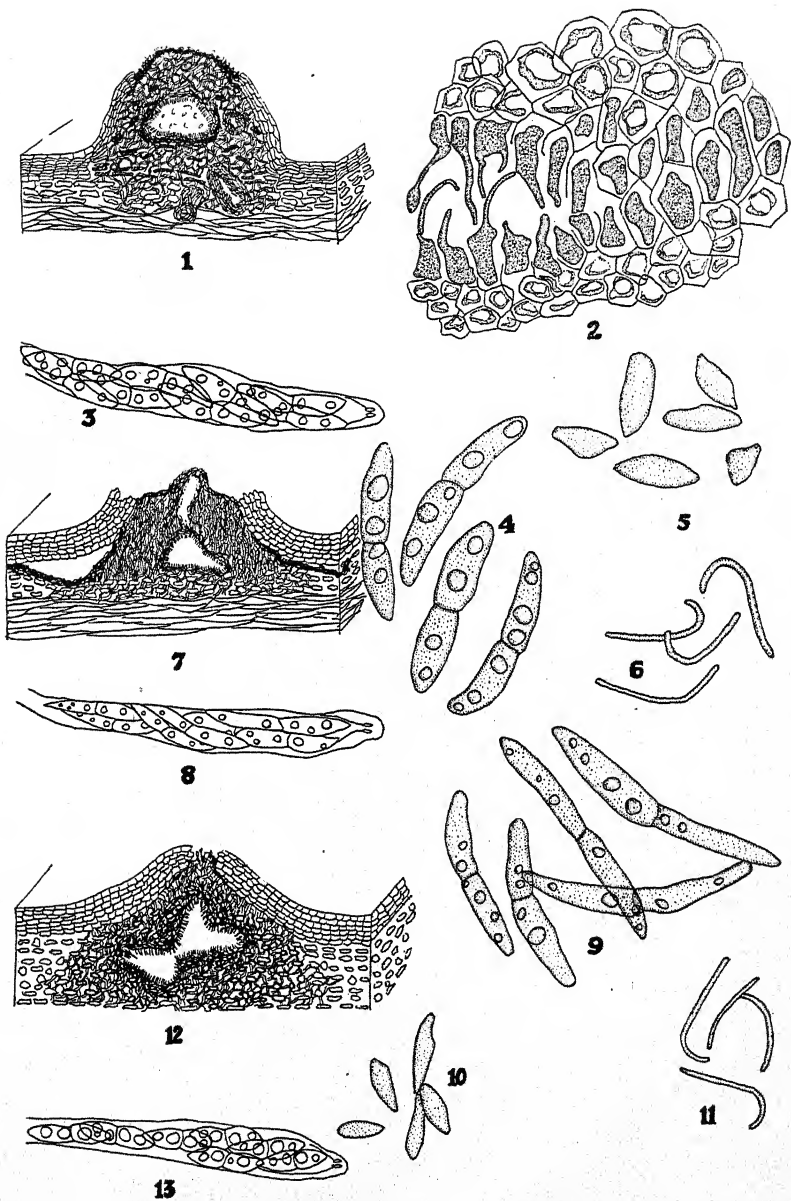
Fig. 7. Vertical section through pycnidial fruit body as produced in culture on *Rhus Vernix* L. and *R. Toxicodendron* L.

Fig. 8. Ascus with ascospores.

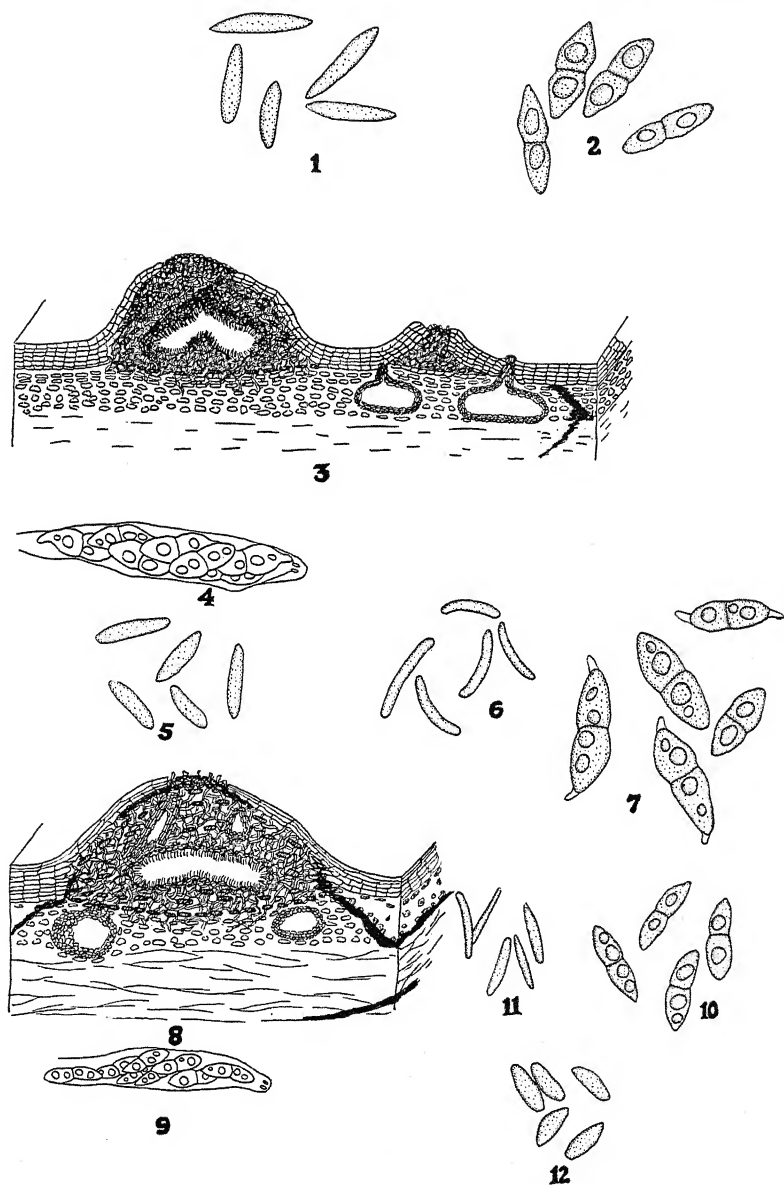
Fig. 9. Ascospores.



DIAPORTHE SPP.



DIAPORTHE SPP.



DIAPORTHE SPP.

- Fig. 10. Alpha type of conidia produced in culture.
Fig. 11. Beta type of conidia produced in culture.
Fig. 12. Vertical section of pycnidial stroma of *Diaporthe rhoina* (Cooke & Ellis) Ellis as formed in culture on twigs of *Rhus*.
Fig. 13. Ascus of *D. rhoina* with ascospores.

PLATE 15

- Fig. 1. Alpha type of conidia of *D. rhoina* produced in culture.
Fig. 2. Ascospores of *D. rhoina*.

Diaporthe decedens (Fries) Fuckel

Fig. 3. Vertical section through fruiting area showing pycnidial stroma, perithecia separately erumpent about an ectostromatic disc, and blackened marginal zone as produced in culture on twigs of *Corylus americana* Walt.

- Fig. 4. Ascus with ascospores.
Fig. 5. Alpha type of conidia produced in culture.
Fig. 6. Beta type of conidia produced in culture.
Fig. 7. Ascospores.

Diaporthe strumella (Fries) Fuckel

Fig. 8. Vertical section of pycnidial fruit body, with perithecial initials in entostromatic area beneath, as formed in culture on twigs of *Ribes*.

- Fig. 9. Ascus with ascospores.
Fig. 10. Ascospores.
Fig. 11. Beta type of conidia produced in culture.
Fig. 12. Alpha type of conidia produced in culture.

OEDOCEPHALUM FIMETARIUM AND PEZIZA VESICULOSA VAR. SACCATA IN MUSHROOM BEDS

F. C. STEWART

During the winter of 1925-26 the writer conducted an experiment with mushrooms in nine small beds, each 1.2×1.5 meters, under a bench in a greenhouse.¹ In beds 1, 2, 4, 5, 7, and 8 horse-manure compost was used. Beds 3 and 6 contained compost prepared from a mixture of bean-straw,² tree leaves,³ and soil. Bed 9 had an 8-centimeter layer of the bean-and-leaves compost in the bottom covered with 13 cm. of horse-manure compost. The beds were spawned on December 1 and cased with 3.5 cm. of sifted loam on December 15.

Between spawning and casing the three beds containing bean-and-leaves compost (Nos. 3, 6, and 9) became almost completely overgrown with a fawn-colored mold from which the six other beds were entirely free. A few days after casing the same mold appeared on the surface of the casing soil in the same three beds. By December 30 it covered about one half of the total surface of beds 3 and 6 and five sixths of the surface of bed 9. At a few points it had climbed over the low board partitions and extended its growth a few inches into adjoining beds, but did not appear elsewhere in any of the six other beds.

When young, the mold is whitish, but it soon changes to fawn-color or pale cinnamon-brown. It is composed of slender, branched, septate, hyaline hyphae which form a thin, loose growth on the surface of the soil over circular areas 7-12 cm. in diameter. Examination with a hand lens reveals multitudes of small, white, spherical bodies borne at the tips of short stalks. Under greater magnification the white bodies are seen to be the

¹ A full account of this experiment will be given in a forthcoming bulletin of the New York State (Geneva) Agricultural Experiment Station.

² Refuse from the threshing of beans consisting chiefly of stems and pods.

³ Principally fresh-fallen leaves of horse-chestnut and maple.

inflated tips of conidiophores with many elliptical, non-septate, hyaline conidia attached. The conidiophores are erect, septate, and usually simple. The conidia measure $6-10 \times 3-3.5 \mu$ and the inflated tip of the conidiophore has a diameter of $25-30 \mu$.

The mold appears to be *Oedocephalum fimetarium* (Riess) Sacc. It has been described and figured by Fresenius (3) under the name *Haplotrichum fimetarium* Riess and by Thaxter (7) under the name *Oedocephalum pallidum* (Berk. & Br.) Cost.

About December 22 apothecia of a species of *Peziza* began to appear outside of beds 3 and 6 along the crack between the cement floor and the boards which formed the walls of the beds. Apparently, mycelium of the fungus in the compost had grown out through the cracks to form its fruit-bodies in the air. A few days later similar apothecia appeared outside bed 9 in the same position, but none ever appeared on the floor around any of the six other beds.

On December 27 *Peziza* apothecia began to break through the casing soil in beds 3 and 6. By January 7 the casing soil in these two beds was cracked and elevated in about 20 places, due, apparently, to forming apothecia. Upon investigation it was found that the apothecia were seated upon the bean-and-leaves compost and only the larger ones were tall enough to reach above the surface of the casing soil. Subsequently, a few surface-growing apothecia appeared in beds 3 and 6 and several appeared, also, in bed 9. Only one apothecium of the subterranean type occurred in bed 9.

In each of four of the remaining six beds there was a single *Peziza* apothecium. These were all of the surface type and in every case situated close to the edge of the bed where there had been an invasion of the fawn-colored mold. That is to say, the *Peziza* apothecia grew only where the fawn-colored mold had appeared a few days earlier.

The free-growing apothecia are at first nearly spherical and whitish. As they enlarge and mature some become cup-shaped or saucer-shaped while others take irregular forms. Those forming beneath the casing soil were invariably very irregular. Mature apothecia are pale yellowish-brown or buff-brown above and whitish beneath. The stem is short and stout. The flesh

is thick and very brittle. The hymenium is usually coarsely ridged in the irregular manner described as cerebriform. The plants grow either singly or in crowded clusters of a few individuals which are sometimes fused into an irregular mass. The apothecia are commonly 5-10 cm. in diameter and often weigh 50-100 gms. each.

Some of the apothecia were quite regular, while others were very irregular. In some the hymenium was nearly even, while in others it was strongly cerebriform. There were, also, all manner of intermediate forms and the microscopic structure was the same in all. Hence, it appears probable that all belong to a single species. Many of our specimens agree closely with Boudier's colored illustration of what he calls *Aleuria vesiculosa* Bull. var. *saccata* Fries⁴ (1) and with Levine's figures of that variety (4, figs. 8, 9). The paraphyses are simple and but slightly thickened at the tip exactly as figured by Boudier. The asci, which are somewhat truncate at the apex, measure $18 \times 255-330 \mu$ and the ascospores $11-12 \times 21-24 \mu$. Upon treatment with iodine the tips of the asci turn light blue.

The appearance of the *Peziza* apothecia exclusively on areas recently overgrown with the *Oedocephalum* strongly suggests a genetic relationship between these two forms. A few attempts were made to grow the two fungi in pure cultures, but as these all failed we are unable to offer any evidence of genetic relationship except such as is furnished by their close association. However, references to such a relationship between *Oedocephalum fimetarium* and species of *Peziza* or *Aleuria* are to be found in mycological literature.

In 1886 Vuillemin (8) described a Discomycete to which he gave the name *Aleuria asterigma*. At the same time he described and figured (but did not name) an associated conidial form which Costantin (2), two years later, referred to *Oedocephalum fimetarium*. In 1891 Thaxter (7) stated that the synonymy of this species was much confused, but that, in his opinion, *Haplotrichum fimetarium* Riess and *Oedocephalum fimetarium* Sacc. should be regarded as synonyms of *Oedocephalum pallidum* (Berk. & Br.) Cost.; also, that Costantin was right in his disposition of Vuil-

⁴ *Peziza vesiculosa* Bull. var. *saccata* Fries according to present nomenclatorial usage in America.

lemin's fungus. On the other hand, Rehm (5) gives *Oedocephalum fimetarium* as the conidial form of *Pustularia vesiculosa* (= *Peziza vesiculosa* Bull. = *Aleuria vesiculosa* Boud.).

According to the description given by Vuillemin, *Aleuria asterigma*, or *Peziza asterigma*, as it is also called (6), is a much smaller and otherwise different fungus than the one which grew in our mushroom beds. However, Boudier is said to have pointed out that it has some analogy to *Peziza vesiculosa* (8).

Levine (4) has reported the occurrence of *Peziza vesiculosa* and *Peziza vesiculosa* var. *saccata* on the manure of newly made mushroom beds under benches in a greenhouse in the vicinity of New York. "The plants appeared in great clusters weighing from 1/2 to 2 lbs." He assumed that either the manure or the soil used in casing was responsible for the presence of the *Peziza*, but suggested that the spawn used was not beyond suspicion. No mention was made of an associated conidial form.

In the case which we have described above neither the spawn nor the casing soil could have been responsible because they were the same in all nine beds, while, with a few readily explainable exceptions, the *Peziza* was confined to the three beds containing bean-and-leaves compost. Clearly, the *Peziza* had its origin in the bean-and-leaves compost.

Edibility tests of the *Peziza* indicate that the fungus is not poisonous but has no value as an esculent.

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TWO UNUSUAL WATER MOLDS BELONGING TO THE FAMILY LAGENIDIACEAE

G. W. MARTIN

(WITH 1 TEXT FIGURE)

Very few fungi belonging to the Lagenidiaceae have been reported from North America. The two species which are the subject of this note were found attacking a large species of *Cladophora* in West Okoboji Lake, Dickinson County, Iowa, during the summer of 1925. In both instances a relatively small number of cells of the host were attacked, but the fungi are so distinctive as to leave no doubt of their identity in spite of the small number of individuals observed. These species have been known heretofore only from a few isolated localities in Europe.

Myzocyttium proliferum A. Schenk (FIGS. 1, 2) was first described from Germany in 1857 as a *Pythium*. The following year Schenk established the genus *Myzocyttium* to contain it. It has since been noted from several European localities on various filamentous green algae and desmids. The primitive mycelial filament breaks up into a chain of bead-like cells, some of which function as zoösporangia, others as antheridia or oogonia (FIG. 1, a). The discharge of zoöspores was not observed in the Iowa material, but the empty sporangia occurring in the same chains of cells as the oogonia and antheridia are striking and unmistakable.

Achlyogeton entophyllum A. Schenk was described in 1859 from Bavaria¹ where it was found attacking *Cladophora* in company with the preceding species, exactly the situation in which it occurred in Lake Okoboji. It resembles *Myzocyttium* in its general aspect, but differs in two important particulars. None of the cells of the filament functions as an oogonium or antheridium but all become sporangia; and the zoöspores, upon discharge, do not immediately swarm, as in *Myzocyttium*, but

¹ Bot. Zeitung 17: 398-400. 1859.

become encysted in a globose cluster at the mouth of the sporangium, as in *Achlya*, each zoospore later escaping for its second active period through a pore in its individual cyst (FIG. 1, c). Sexual reproduction seems to be lacking. In the Okoboji material, however, I find constantly associated with the sporangia, although in different cells of the host, resting spores quite evidently formed by encystment of the contents of a cell similar to that of the cell of an *Achlyogeton* filament (FIG. 1, d).

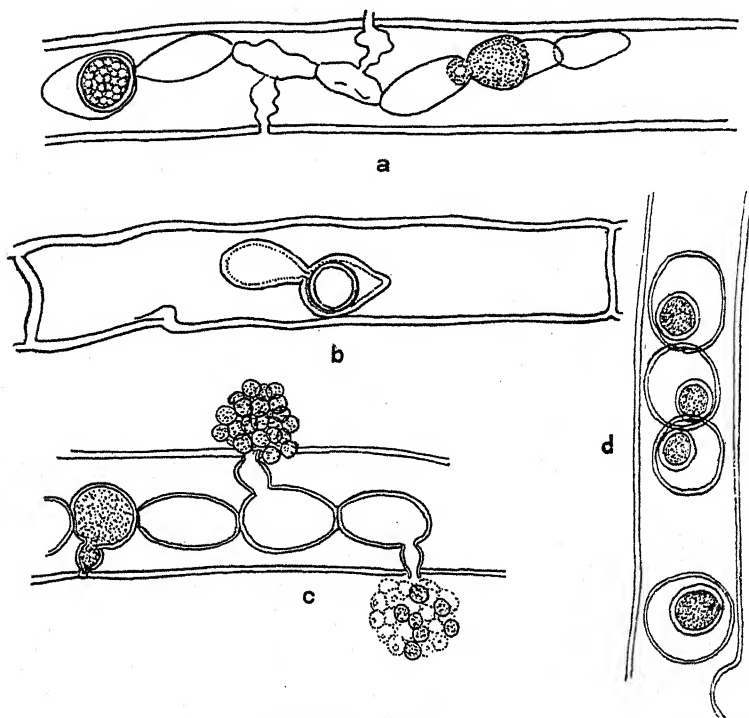


FIG. 1. *Myzocytiium proliferum*. Filament in cell of *Cladophora*. At left, mature oospore with adjacent antheridium; center, two empty sporangia; right, fusion of contents of antheridial and oogonial cells; extreme right, empty sporangium; 2. Short filament of two cells functioning as antheridium and oogonium; 3. *Achlyogeton entophyllum*. Part of a chain of sporangia in a cell of *Cladophora*, showing, from left to right, immature sporangium, empty sporangium, spores encysted at mouth of sporangium, cysts nearly all emptied; 4. Asexual resting spores in filament of *Cladophora*. Possibly resting spores of *Achlyogeton*.

a-c, from living material; d, from preserved material. All drawings made with camera lucida using Zeiss objective D and ocular 4, reduced in reproduction to 500 diameters.

There is never any trace of sexual fusion in connection with these bodies. It is possible that they represent resting cells of *Achlyogeton*.

Except for a doubtful reference by Sorokin,² who found what he took to be this species parasitizing eel-worms in the Caucasus, I find no record of its observation since its original description.

² Ann. Sci. Nat. VI. 4: 62-71. 1876.

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A PINK-COLORED FORM OF POLYPORUS SULPHUREUS AND ITS PROBABLE RELATIONSHIP TO ROOT- ROT OF OAKS

H. R. ROSEN

(WITH PLATES 16 AND 17)

For several years a very conspicuous polypore has been found associated with living oak trees on the campus of the University of Arkansas. Most of these trees represent native wild plants that existed prior to the present use of the land, and are over fifty years of age. A number have been cut down and the same polypore noted near the stumps. While one may expect trees that are seventy-five years old or older to show some weakening, yet the marked signs of debility shown by some of them in the form of large, dead limbs and portions of trunks indicate that these trees are probably suffering from additional causes.

The fungus referred to has usually been seen on the ground, near the trees (PLATE 16) or directly at the base of the trunk. Never has it been noted any distance up the trunk, above the soil line, and indeed, superficially, it almost always appears as a soil inhabitant. But without observing the relationship of the fungus to the roots, it has always been a question with the writer whether the polypore had anything to do with the decay of the trees. In the spring of 1926, however, excellent opportunity was afforded to study this, for quite a few fruiting bodies were observed near the base of living, black oak trees. When some of these were carefully dug up, it was observed that the fungus in every instance was growing out of or attached to roots that were badly decayed. These roots in turn were then traced to the trunks of the living oak trees. A conspicuous characteristic of the fungus is its habit of living in and permeating the soil for distances of a foot or more around the rotted roots.

Large chunks of such soil when dug up show a spongy or punky consistency and are speckled with the whitish mycelium. One good distinguishing character of this polypore is the production of turbid drops, which ooze out of the mycelial strands when they are broken or disconnected. These drops are not quite as whitish as the milky juice of such fungi as the species of *Lactaria*. They have been found oozing from the broken surface at the point of union between the pilei and the underground mycelium (PLATE 16, lower figure), from the disjointed mycelium found in the soil, and lastly from the mycelium found within the decayed roots. It is usually not to be observed in the pilei unless these are subjected to pressure.

Attacked roots are very much discolored, the blackish or dark brown color being noticeable clear through a root which is two inches in diameter. Only the cortical regions have been found to be much disintegrated, but the writer is not sure that he has seen all the stages of decay. Small decayed roots as well as large ones having been observed, with the fungus in association, and having in no case observed any decided rotting of the interiors, it may be doubted for the present if this fungus can produce heart-rot.

Aside from its probable parasitic relationships the fungus is also interesting from a taxonomic viewpoint. It appears to be closely related to *Polyporus sulphureus*, and Dr. L. O. Overholts considers it as such. It however shows some marked differences from the usual forms of that species. The surface of the pilei never shows a yellow or sulphur-yellow color, but a very distinct pinkish-salmon color, salmon-buff of Ridgway, when fresh. Upon bruising, the flesh beneath the upper surface becomes conspicuously reddish or flesh colored. The surface of old dried-out pilei is dirty white or cream colored. The hymenial layer is creamy-white and the mouths of the pores never show a sulphur-yellow color. They are either creamy-white or pinkish in very young stages, and when the spores are being formed. In well-developed specimens the pores are markedly daedaleoid (PLATE 17) and the tubes are rarely more than 1 mm. long. The mouths are noticeably notched, irregular, almost ipriciform in fresh material. In dried specimens these features are more

or less completely lost. Due to the fact that the hymenium is mostly found in an underdeveloped stage, spores are rather difficult to find. Out of about seven years of observation, this is the first year that I have found good sporulating specimens. The description of spores of *P. sulphureus* given by Overholts (Washington Univ. Studies, vol. 3, no. 1, p. 24, 1915) fits very well indeed, and in spite of the number of characters which distinguish it from the common (northern?) form, the similarity of spore color, size, and form indicates, perhaps, a close relationship. Another feature possessed by this salmon-colored form, not mentioned for the sulphur-colored one, is a noticeable calcareous incrustation, quite conspicuous on the surface of pilei, limy particles also being observed in microscopic mounts of the hymenial layer. In size this fungus is very variable, but on the whole larger than ordinary clusters of *P. sulphureus*. Measurements up to 60 cm. in the widest diameter are not rare (PLATE 16), although specimens measuring 30-40 cm. are around the average. Hence, if this is to be included in *P. sulphureus*, the measurements of $5-20 \times 4-12 \times 0.5-2.5$ cm., as given by Overholts, would require considerable revision. Measurements of the flesh-colored pilei are $20-60 \times 15-40 \times 3.0-10$ cm. The context is noticeably pinkish for a considerable distance below the upper surface, and grades off into a creamy-white or whitish color near the lower surface. There are no cystidia, but there are numerous sterile, thread-like hyphae at and near the partitions (PLATE 17).

The foregoing description has been submitted to Dr. Overholts for his criticism, and the writer is taking the privilege of quoting a part of his letter. "I believe, for the present, that you are wise in simply noting the points in which it varies from typical *sulphureus*. I still believe there is room in our taxonomic system for those segregates that used to be referred to as varieties, and would suggest that you propose for it a varietal name. I do not think it is entitled to more at present, and I think its variations have never been pointed out—certainly not in *Dae-dalea*."

As Dr. Overholts, an eminent student of the difficult group to which this fungus belongs, has given material assistance in

its identification, the following combination is proposed: *Polyporus sulphureus* (Bull.) Fries var. *Overholtsii* var. nov.

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EXPLANATION OF PLATES

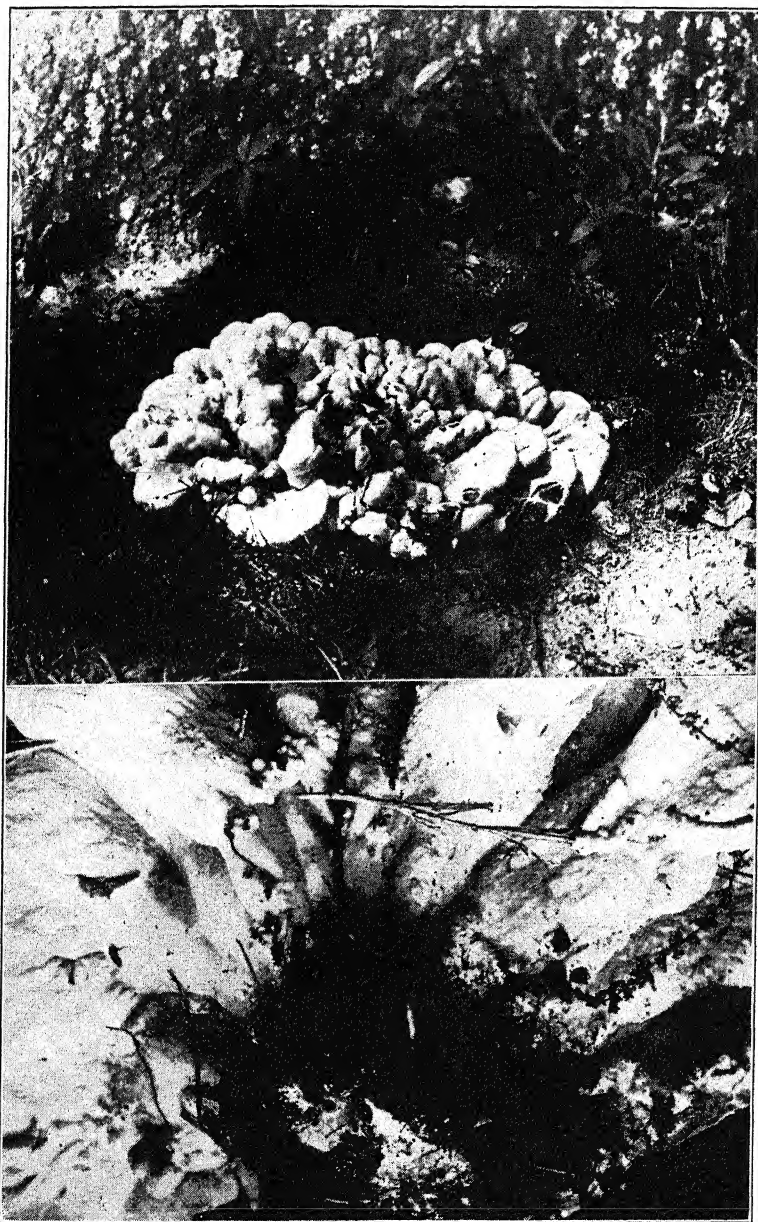
Plate 16. Upper figure. Cluster of pilei of *P. sulphureus*, near the base of a living, black oak. It was carefully removed and the mycelium below it found surrounding and permeating roots of the oak. The cluster measured 60 cm. in the widest diameter. Photographed May 10, 1926, Campus, University of Arkansas.

Lower figure. Hymenial layers bordering the point of union of pilei and mycelium in soil. Notice the large, irregular drop of fluid (exudate) near the patch of mycelium toward center of darkish soil mass. This is the average appearance of a hymenial layer and, being underdeveloped, few spores are to be found. Slightly reduced.

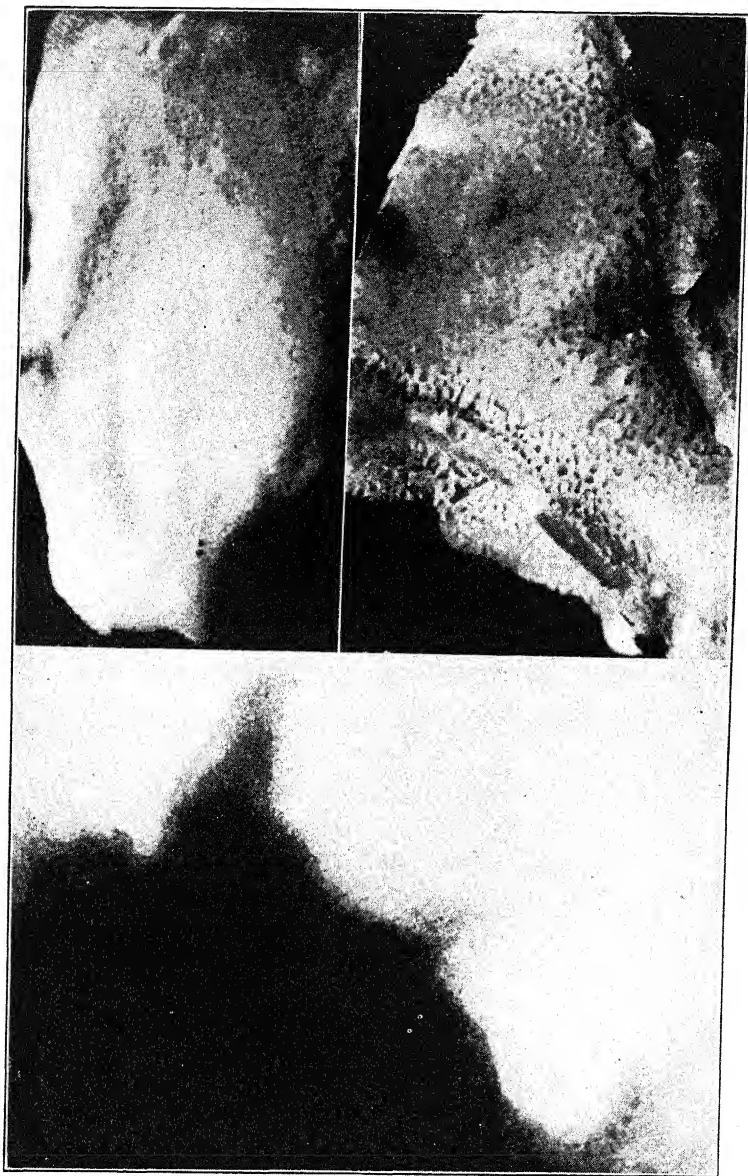
Plate 17. Upper left-hand figure. Immature or non-spore-bearing hymenium. The pores are separate and distinct. This is the form in which the hymenium is usually found. Magnified about 5 times.

Upper right-hand figure. Fully developed, sporulating hymenium, showing the daedaleoid nature of the pores and the irregularly cut, irpiciform openings. Magnified about 5 times.

Lower figure. Microphotograph of pores showing type of partitions indicative of the irregular labyrinths. Also the elongated, sterile hyphae at the partitions. Magnified about 50 times.



POLYPORUS SULPHUREUS VAR. OVERHOLTSII



POLYPORUS SULPHUREUS VAR. OVERHOLTSII

CRITICAL REMARKS ON CERTAIN SPECIES OF SCLEROTINIA AND MONILIA ASSOCI- ATED WITH DISEASES OF FRUITS

JOHN W. ROBERTS AND JOHN C. DUNEGAN

INTRODUCTION

The taxonomic position of certain species of *Sclerotinia* and *Monilia* which cause diseases of fruits throughout the world has been for many years in a chaotic state. A number of factors are responsible for this but as Wormald (20) points out the most important ones are the comparatively rare occurrence of the ascogenous forms in many parts of the world and the varying responses of the monilial forms to different environmental conditions. The placing of certain species of *Monilia* in the genus *Sclerotinia* before the discovery of their sclerotinial stages and the assumption that ascogenous forms occurring in America are related to monilial forms occurring in Europe are additional factors.

The status of the various species has become so obscured by contradictory statements that the authors have proposed the following dicta as a guide in the study of the validity of the species.

1. Names of species to be valid must be accompanied by adequate descriptions, properly published.

2. Assumptions that species of *Monilia* have species of *Sclerotinia* as ascogenous stages are permissible but scientific names based on unknown ascogenous forms are not valid.

3. Whenever possible the connection between the species of *Sclerotinia* and the species of *Monilia* must be demonstrated if it is to be accepted.

The writers feel that these dicta involve no departure from the established rules of procedure universally recognized.

HISTORICAL REVIEW

For many years European pathologists believed that there was only one species of *Monilia* attacking fruits in Europe,

namely, the *Monilia fructigena* of Persoon (9, 10). In 1851 Bonorden (3) had described another under the name *Monilia cinerea*, but the distinction between the two species was long in question. In 1900, however, Woronin (22) demonstrated that the *Monilia fructigena* of Persoon and the *Monilia cinerea* of Bonorden are distinct species.

A similar state of affairs existed in America where the common brown-rot fungus was considered to be *Monilia fructigena* although Smith in 1889 (17) had noted that its conidial tufts were ash-gray rather than buff. Aderhold and Ruhland (1) stated in 1905 that the American form was not *Monilia fructigena* but *Monilia cinerea*. As the result of extensive cultural work by Matheny (6) and others employing European and American material it became evident that the American form closely resembled *Monilia cinerea* of Europe. No form resembling *Monilia fructigena* was found nor has such a form been reported in America up to the present time.

In 1923 Barss (2) stated that in addition to the common form prevalent in the United States there is another *Monilia* present in Oregon which attacks the blossoms, spurs and twigs of stone fruits and certain varieties of pears but produces little fruit-rot. This fungus had been mentioned by Jackson (5) as early as 1915 and later was investigated by Posey (12) whose main study has not been published. On artificial media the fungus showed decided differences when compared with the more common form. Barss (2) named it *Monilia oregonensis* Barss and Posey, with a statement that a formal description had been submitted for publication. The formal description has not appeared and *Monilia oregonensis* must be considered a *nomen nudum*. Rudolph (15) later described a blossom blight of apricots in California caused by apparently the same fungus. Ezekiel (4) in 1925 comparing material received from Barss and from Rudolph with the true *Monilia cinerea* of Europe came to the conclusion that the *Monilia oregonensis* of Barss and Posey occurring in Oregon and California agrees in all details with *Monilia cinerea* and that the two should probably be considered identical. He writes: "*Monilia oregonensis* Barss and Posey agrees morphologically, culturally and in its life

history with *S. cinerea*, and is doubtless to be considered synonymous." Since the apothecial stage of the Oregon fungus has not yet been found, it is evident that the agreement was with the monilial stage of *Sclerotinia cinerea*, i.e., *Monilia cinerea*.

In 1888 Woronin (21) demonstrated the connection between a species of *Monilia* and a species of *Sclerotinia* occurring on *Vaccinium vitis-idaea*. This was the first time a connection between species of these genera had been demonstrated and furnished the basis for the assumption made by Schröter (16) in 1893 that *Monilia fructigena* and *Monilia cinerea* are conidial forms of *Sclerotinia*. He therefore proposed the names *Sclerotinia fructigena* and *Sclerotinia cinerea* for the two species, the apothecial stages of which were at that time unknown.

In 1902 Norton (7) found apothecia of a species of *Sclerotinia* developing from peach mummies and demonstrated their connection with the common *Monilia* of stone fruits. Assuming the species of *Monilia* common in America to be identical with *Monilia fructigena* of Europe, he named the fungus *Sclerotinia fructigena*.

In 1905 Aderhold and Ruhland (1) announced the discovery of a species of *Sclerotinia* which they demonstrated through ascospore cultures to be connected with *Monilia fructigena*. In the same paper they described *Sclerotinia cinerea* basing the description of the apothecial stage on preserved American specimens sent them by Norton and that of the conidial stage on material collected by them in Europe. Since they were of the opinion, as previously pointed out, that the imperfect stage of the American brown-rot fungus was the same as *Monilia cinerea* of Europe, they considered Norton to be in error in calling his fungus *Sclerotinia fructigena*. This view was supported by the results of investigations by Matheny (6) and others.

In 1919 Wormald (19) pointed out that both *Monilia fructigena* and *Monilia cinerea* occur in England and that *Monilia cinerea* includes two biological forms which he designated as forma *Mali* and forma *Pruni*. These forms he recognized as the result of inoculation experiments on apple blossoms. In 1920 he (19) further demonstrated that these biological forms could

be distinguished in the laboratory by differences in enzyme production and that the behavior of the American *Monilia* resembled more closely that of forma *Mali* than that of forma *Pruni*. He also observed differences in the manner of growth of the European *Monilia cinerea* and that of the American *Monilia* on artificial media and differences in the lengths of their germ tubes before branching. With these differences in mind he regarded the American form as distinct, provisionally referring to it as *Monilia cinerea* forma *americana*.

Less than a year later the same author (20) reported the discovery of a species of *Sclerotinia* on plums in England which he showed to be the perfect stage of *Monilia cinerea* Bon. Since this was the perfect stage predicated by Schröter, he accepted the name *Sclerotinia cinerea* (Bon.) Schröter for it and presented a somewhat detailed discussion of its morphological characters.

In December 1923 at the Cincinnati Meeting of the American Phytopathological Society, Norton & Ezekiel (8) stated that as a result of their studies they had not only confirmed Wormald's findings as to differences between the European and American imperfect forms but felt that the American was sufficiently distinct from the European to warrant specific rank. They proposed the name *Sclerotinia americana* (Wormald) comb. nov. for the American form and stated: "This is the fungus widely destructive in this country, whose apothecial stage was described by Norton, and which was studied and described by Reade, Matheny, etc."

As early as 1909 Pollock (11) called attention to Winter's description of the fungus *Ciboria fructicola* Winter, a name which Saccardo later changed to *Sclerotinia fructicola* on the authority of Rehm. Pollock asserted that here was a valid description of a species of *Sclerotinia* which Rau found on peach mummies at Bethlehem, Pennsylvania in 1883 and which was probably the perfect stage of our common brown-rot fungus. Through the coöperation of Dr. C. L. Shear, the authors in 1923 obtained from Mr. Eugene Rau material of the original collection part of which he had sent to Winter in 1883. Studies of this material published elsewhere (14) indicated the identity of this cotype material of *Sclerotinia fructicola* with the ascog-

enous stage of the American brown-rot fungus as it appears today.

DISCUSSION

Having enumerated the various names applied to certain species of *Monilia* and *Sclerotinia* occurring in Europe and America, it will be interesting to consider their validity with reference to the dicta previously laid down.

The names *Monilia fructigena* and *Monilia cinerea* established by Persoon and by Bonorden respectively are obviously valid as they cover species shown by many investigators to be distinct and were properly published with adequate descriptions.

Schröter's new combinations *Sclerotinia fructigena* and *Sclerotinia cinerea* published in 1893 can not be considered valid as they were based only on the assumption that species of *Monilia* would have species of *Sclerotinia* for their perfect stages. Of *Sclerotinia fructigena*, Schröter writes "Schlauchfrucht unbekannt" and of *Sclerotinia cinerea* "Nur Conidienfrüchte bekannt." In reality his descriptions are only redescriptions of the *Monilia fructigena* and *Monilia cinerea* already described by Persoon and Bonorden respectively.

Winter's description in 1883 of the ascomycete which he named *Ciboria fructicola* and which Saccardo later changed to *Sclerotinia fructicola* is a valid description of a *Sclerotinia* arising from peach mummies and which is almost certainly identical with the species commonly found on peach mummies today. Unfortunately, at that time, the connection between this form and the species of *Monilia* rotting the fruits was not recognized. However, apothecia of the cotype material collected by Rau in 1883 appear to be morphologically identical with those which are commonly found today and which are known to be connected with the *Monilia* causing the common rot of peaches. The belief in the identity of *Sclerotinia fructicola* with the common species of today is further supported by the fact that the month of May is the time of the year when in the latitude of Bethlehem, Pennsylvania, the sclerotia on mummied fruits are producing apothecia. In a previous publication on this subject the authors stated (14): "It seems certain that in 1883 Rau collected and Winter described the species of *Sclerotinia* which Norton in 1902

showed to be the ascogenous stage of our common brown-rot fungus."

It was not until 1902 when Norton rediscovered the apothecial stage that the connection between the *Monilia* and a species of *Sclerotinia* in America was established. Norton thought the fungus to be the *Sclerotinia fructigena* predicated by Schröter and accordingly gave it that name. The ascospores gave rise to the common species of *Monilia*, which Norton like other American investigators assumed to be identical with *Monilia fructigena* of Europe.

Aderhold and Ruhland in 1905 established the name *Sclerotinia fructigena* on valid grounds. By means of cultures they demonstrated that ascospores from the apothecia, which they had discovered, gave rise to a typical growth of *Monilia fructigena*. The status of their species, *Sclerotinia cinerea*, is somewhat different. Believing the American fungus not to be *Sclerotinia fructigena* as claimed by Norton but the *Sclerotinia cinerea* of Schröter, they presented a formal scientific description using preserved material received from Norton as a basis for the apothecial description and fresh European material of *Monilia cinerea* for the conidial. This procedure was perfectly logical from their viewpoint, but as will be shown later there is now strong evidence for believing that *Monilia cinerea* of Europe is not the same species as the common American fungus. Wormald (20) apparently believed them not to be identical for he states "Aderhold and Ruhland's assumption that the American *Sclerotinia* is a stage in the life-history of the European *Monilia cinerea* Bon. is untenable." If, as there are good reasons for believing, the two are not identical, Aderhold and Ruhland's description cannot be considered valid.

In 1921 Wormald in England found and described apothecia on plum mummies and, after demonstrating their connection with *Monilia cinerea*, he termed the fungus *Sclerotinia cinerea* (Bon.) Schröter, thus validating that name.

In 1923 Norton and Ezekiel proposed a new name for the American fungus, i.e., *Sclerotinia americana*, feeling that it was sufficiently distinct from European forms to warrant specific rank. In 1924 the authors after showing that the cotype

material of *Sclerotinia fructicola* is morphologically identical with the species of *Sclerotinia* commonly occurring on mummied fruits called attention to the fact that if the American fungus is considered a distinct species the name *Sclerotinia fructicola* has priority over other names. The following year Ezekiel (4) stated: "If means of distinguishing *S. americana* from *S. cinerea* by the apothecial characteristics should be worked out, we might then be able to identify the dried specimens of Winter more definitely with *S. americana*, which would then properly be called *S. fructicola*. For the present, it seems preferable to use Wormald's name *americana*, which was published with the first description that differentiated the American species from the earlier known European forms." The authors fail to agree with Ezekiel's reasoning. They do not feel that the problem of distinguishing between apothecia of *Sclerotinia cinerea* of Europe and the apothecia of the common American form has anything to do with the problem of the identity of the latter with Rau's material of *Sclerotinia fructicola*. They are two separate and distinct problems. The writers' (14) studies have shown that the apothecial characters of *Sclerotinia fructicola* agree very well with those of the species of *Sclerotinia* commonly found on mummied peaches in America at the present time. Finally if one believes that the imperfect stages of the European form and the American form are different enough to consider them distinct species, then surely he should consider that the perfect stages are distinct or admit the apparent absurdity that an apothecial form can give rise to two distinct monilial forms each one worthy of specific rank. If the American fungus is considered a species distinct from the European and is admitted to be identical with the species of *Sclerotinia* found by Rau, then there is no escape from the priority of the name *Sclerotinia fructicola*.

At the time the authors published their account of *Sclerotinia fructicola* they were aware of certain differences between *Monilia cinerea* of Europe and the common *Monilia* of America. These differences were physiological rather than morphological in character or were not pronounced enough to convince the writers that without additional evidence the two forms should be

regarded as distinct species. The copious production of conidial masses on the spurs and twigs by the European form and the comparative rarity of such production by the American form they felt might possibly be due to differences in environmental conditions and believed that possibly the American form if introduced into Europe might respond in a fashion similar to the European form. Differences in the mode of branching of the germ tubes as first pointed out by Wormald were recognized, but the use of this as a major diagnostic character would preclude the identification of nonliving material. One other feature, namely the rare occurrence of apothecia in the European form as contrasted with the American form, was recognized and was considered as possibly the result of environmental conditions. However, the discussion, by Barss (2), of the Oregon fungus sheds considerable light on the problem. Here was a demonstration, under environmental conditions very similar to those of Europe, of the behavior of the common American form and of another fungus which, as shown by Ezekiel (4), agrees both morphologically and in its physiological behavior with *Monilia cinerea* of Europe. The differences in the physiological behavior were apparently uninfluenced by the environmental conditions. The common American form continued to attack blossoms, rot the fruit, and produce apothecia abundantly but the other form was mainly a spur and blossom inhabiting form producing conidia late in the winter or early spring with only a negligible amount of fruit-rot. Barss (2) states: "In tests it [the Oregon form] failed to produce the apothecial (spore-cup) stage under conditions that gave abundant development of this stage with the ordinary brown-rot fungus. It produces spores in chains very closely resembling those of ordinary brown-rot, but it differs from the latter in the appearance and manner of spore production on the host plant."

The authors have specimens of the Pacific Coast fungus which were sent them by Mr. B. A. Rudolph, of the California Agricultural Experiment Station. The specimens consist of apricot twigs showing compact tufts or pads of hyphae and conidiophores on or about the bases of the old fruit stems. The tufts or pads are ashen gray and, being a millimeter or more across, are easily

visible to the naked eye. They are not easily rubbed off and persist in dried material. No such tufts or pads are found on twigs invaded by the common brown-rot fungus, the nearest approach to them being the delicately fragile tufts of conidial chains which, being easily dislodged, are seldom found in dried specimens. Cultural work performed by the authors confirms that of Barss (2) and of Ezekiel (4).

A consideration of all these facts leads the authors to recede from the position taken in their previous paper, *i.e.*, that they preferred to retain *Sclerotinia cinerea* as the name for the fungus causing the common fruit-rot in America. The physiological differences which they hesitated to accept as criteria for the separation of the species have been shown to persist when the two species occur naturally under environmental conditions similar to those of Europe. Moreover, it is possible to separate the two in the orchard or in herbaria. Even if the Oregon form is later shown not to be identical with *Monilia cinerea* of Europe, it is much more closely related to that form than is the common American form. Accordingly the authors feel that the common American brown-rot fungus is to be considered a distinct species. Its name should be *Sclerotinia fructicola*, the first name applied to it and one accompanied by an adequate description.

A formal scientific description of both the perfect and imperfect forms was published by Reade (13). Although he wrongfully used the name *Sclerotinia fructigena*, his description is an excellent one and is the only one known to the authors that includes both stages.

SUMMARY

The taxonomic position of certain species of *Sclerotinia* and *Monilia* which cause disease of fruits has for many years been in a chaotic state. In order to correct this confusion the following dicta are proposed.

1. Names of species to be valid must be accompanied by adequate descriptions, properly published.
2. Assumptions that species of *Monilia* have species of *Sclerotinia* as ascogenous stages are permissible but scientific names based on unknown ascogenous forms are not valid.

3. Whenever possible the connection between a species of *Sclerotinia* and a species of *Monilia* must be demonstrated, if it is to be accepted.

With these dicta as a guide a critical review of the literature and their own studies lead the authors to conclude:

1. Two species occur on drupaceous and pomaceous fruits in America, one being the common brown-rot fungus and the other a recently discovered form occurring along the Pacific Coast.

2. The common form the writers now believe to be a species distinct from any known European form.

3. The correct name of the common form is *Sclerotinia fructicola* (Wint.) Rehm.

4. The Pacific Coast form is similar to and possibly identical with *Monilia cinerea* of Europe. No perfect stage of this fungus has been found in this country.

5. *Sclerotinia fructigena* is a valid name for a fungus occurring in Europe but not known to occur in the United States.

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NEW SPECIES OF LICHENS FROM PORTO RICO—I. GRAPHIDACEAE

BRUCE FINK

GENERAL INTRODUCTION

For more than a quarter of a century various American botanists, for the most part connected with The New York Botanical Garden, have been collecting lichens in Porto Rico. The writer began determining the *Graphidaceae* collected by these workers in Porto Rico and on adjacent islands in 1911 and his studies of Porto Rican and other tropical lichens have continued to the present time. In November, 1915, he went to Porto Rico for the purpose of becoming acquainted with the lichen flora in general and the *Graphidaceae* in particular.

While the writer was working on the family treated in this contribution the late Dr. L. W. Riddle was making a study of lichens collected during expeditions from The New York Botanical Garden to several tropical islands, including Porto Rico. In this investigation Doctor Riddle determined about 300 specimens from Porto Rico and the Virgin Islands, covering more than 100 species. More recently the writer extended his work to cover all of the collections made from The New York Botanical Garden and this work is still going forward. During this time he has also determined the collections made in Porto Rico by Dr. F. L. Stevens.

The writer's collection of Porto Rican fungi reached approximately 2300 numbers, of which somewhat more than two thirds were lichens. For several years the writer gave his time to studies of the *Graphidaceae*. During this time Mr. G. K. Merrill determined 500 specimens of the Porto Rican collection from many families and genera. At the same time Doctor Riddle determined about 40 specimens from the *Arthoniaceae*. Mr. Ludwig Scriba and Mr. Henri Sandstede handled the rather small collection of *Cladoniae*. This left for the writer approximately 1000 specimens for study. Finally he submitted nearly

150 numbers from the most difficult and critical material to our greatest lichenists, Dr. E. A. Vainio and Dr. A. Zahlbruckner.

The literature of tropical lichens is very incomplete and fragmentary and much of it not easily accessible. Moreover no American lichenist had studied tropical lichens seriously when work was demanded by the collections being made. Consequently the studies have been accomplished with large expenditure of energy, covering many years. As will appear from statements above several lichenists had part in the work, and it is the result of circumstances that the writer is now engaged in bringing the studies to a conclusion.

The writer's herbarium has been greatly enriched during the fifteen years of work on tropical lichens. Practically all of the species collected are represented by one or more specimens, including types or cotypes of all the new species. The writer is adding to the rich collection of tropical lichens in the herbarium of The New York Botanical Garden a nearly complete set of his own collections. Also he is placing as nearly complete sets as possible in the Farlow Herbarium of Harvard University and in the National Herbarium at Washington. Mr. G. K. Merrill is considered next, and after him Professor C. C. Plitt and Mr. S. Rapp.

A large amount of work would be required yet for an approximately complete study of the lichen flora of Porto Rico and adjacent islands. In this connection it is in order to state that a few days of collecting in the region about Yauco indicates plainly that the desert regions of Porto Rico are unique with respect to lichen flora and worthy of very careful study. In this region the lichens are mainly crustose species and one might easily fail to see them and gain the impression that there were few lichens. The present paper, which deals exclusively with new species of obscure, crustose lichens, gives a forecast of the rewards that would result from exhaustive collecting and study of the lichens of the desert regions of Porto Rico. Other papers of this series will furnish even better evidence.

THE GRAPHIDACEAE

It is now 17 years since the writer began studying the *Graphidaceae* of North America. Twelve years ago he went to Porto

Rico and collected the *Graphidaceae* carefully. During the fifteen years of work the literature of the family has been studied carefully and material has been examined in the large American collections and from specimens sent for study by some of the best collectors. Also tropical species preserved in the Herbarium Boissier and the species of *Graphis* in the herbarium of the Naturhistorisches Hofmuseum at Vienna were loaned to the writer for study. The *Graphidaceae* comprise a large and difficult group of more than 1000 species, about one third of which are known in tropical America. Few of our tropical areas have been studied carefully and in none of them have all the new species been discovered, due mainly to the fact that these fungi are among the most inconspicuous lichens and are, consequently, overlooked in general collecting.

The thallus of members of the *Graphidaceae* is uniformly crustose without plectenchymatous cortex. Besides the superficial crustose portion the hyphae penetrate into the substratum, where they form a network. The algal host is usually *Trentepohlia* (*Chroolepus*) as is uniformly the case in the species described herein. *Palmella* is the host in a comparatively small number of genera, which furnished no new species in the writer's collecting in Porto Rico. The algae are almost exclusively within the substratum. The apothecia are usually elongated and more or less branched. In some species they are round to slightly elongated or irregular. The exciple is usually well developed, varying in color from brown to more commonly black or at least blackish. In some instances it is poorly developed, and much lighter colored. The disk is closed and indicated by a depressed line, or more or less open and commonly black or variously pruinose. The hypothecium varies from hyaline to dark brown or nearly black. The hymenium is uniformly hyaline. The paraphyses are hyaline and non-septate. They are roughly parallel and unbranched or interwoven and branched, and usually become gelatinized and sometimes indistinct. The asci are most commonly clavate but may vary markedly from this form. The spores are transversely septate or both transversely and longitudinally septate (muriform) in the species described herein, though in a few species they are non-septate.

The new species from Porto Rico follow, arranged by genera. The types are in the writer's herbarium.

OPEGRAPHA Humb.

1. *Opegrapha dirinicola* n. sp.

Thallus imbedded in the tissues of the host and invisible; apothecia minute, $0.3-0.7 \times 0.1-0.2$ mm., immersed to semi-superficial, straight to rarely somewhat curved, the disk closed and usually indicated by an obscure, depressed, black line, the exciple black; hypothecium dark brown; hymenium hyaline; paraphyses hyaline, distinct, interwoven, and sparingly branched; asci clavate to broadly clavate, the wall not much thickened in the apical region; spores 8, dactyloid, hyaline or tinged with brown, 3-septate, the cells cylindric, $12-16 \times 5-6 \mu$, irregularly arranged.

Parasitic on *Dirina Ceratoniae* on bark in an open field near Mayaguez, Fink 1181a. Supposed to bear a parasitic relation with *Trentepohlia*, the algal host of *Dirina*, on which the new species grows.

2. *Opegrapha minutula* n. sp.

Thallus thin, smooth, ashy gray to whitish; apothecia minute, round to slightly elongated or irregular, 0.15–0.2 mm. across or reaching 0.3 mm. in one direction, partly immersed to adnate, the disk closed or opening slightly and indicated by an obscure, depressed, blackish line, sometimes branching one or more times at various angles from near the center, the exciple black and of moderate thickness; hypothecium thinner and dark brown; hymenium hyaline; paraphyses hyaline, interwoven, and branched, distinct to semi-distinct; asci clavate, the wall not much thickened in the apical region; spores 8, long-oblong, 3-septate, the cells cylindric, hyaline or finally brownish, $18-26 \times 5-6 \mu$, biserially to irregularly arranged.

On bark in an open field near Rio Piedras, Fink 492.

3. *Opegrapha alboatra* n. sp.

Thallus thin, smooth, ashy white, often absent superficially and indicated by surface coloration of the substratum; apothecia minute to small, irregular and 0.2–0.35 mm. across or more often elongated and reaching 0.5–1.5 mm. in one direction, when straight to curved, adnate and often clustered, the disk and the exciple black, the former becoming more or less open and

concave; hypothecium brown; hymenium hyaline; paraphyses hyaline, interwoven and branched, becoming indistinct; asci ovoid-clavate, the wall much thickened in the apical region; spores 8, dactyloid-elliptic, 3-septate, the cells cylindric, hyaline to finally brownish, $22-26 \times 8-10 \mu$, the wall at first thick but becoming thinner, irregularly arranged.

On rocks on a high, exposed hilltop south of Yauco, Fink 1556 and 1592 (type).

4. *Opegrapha subabnormis* n. sp.

Thallus thin, smooth to slightly rough and chinky, light greenish gray to ashy, dissected and bordered more or less by blackish lines; apothecia long but rather narrow, $0.7-4 \times 0.2-0.35$ mm., immersed to semi-superficial, straight, curved or flexuous, rarely branched, the disk closed to open and blackish, or grayish pruinose, the exciple dirty black, surrounded by a whitish, thalloid one; hypothecium brown; hymenium hyaline; paraphyses hyaline, distinct, interwoven, and branched; asci clavate, the wall not much thickened in the apical region; spores 8, hyaline, elliptic, 3-septate, the cells cylindric, $22-27 \times 4.5-5.5 \mu$, irregularly arranged.

On bark in an open field near Mayaguez, Fink 1245.

5. *Opegrapha albidoatra* n. sp.

Thallus thin, smooth, ashy white, becoming slightly rough, chinky and powdery, and sometimes disappearing superficially; apothecia becoming moderately long but narrow, $1-3 \times 0.2-0.3$ mm., numerous and often clustered, partly immersed to adnate, variously curved or flexuous, very rarely branched, the disk closed to more or less open, when whitish pruinose, the exciple black, moderately thick, sometimes covered more or less laterally by a whitish, thalloid one; hypothecium and hymenium hyaline; paraphyses hyaline, interwoven, and branched, distinct to semi-distinct; asci clavate, the wall not much thickened in the apical region; spores 8, oblong-elliptic, hyaline to finally brownish, 4-7-septate, the cells cylindric, $14-18 \times 3-4 \mu$, irregularly arranged.

On bark in various habitats near Naranjito, Fink 142 and 298, near Rio Piedras, Fink 506 (type) and 513.

6. *Opegrapha riopiedrensis* n. sp.

Thallus thin, smooth, ashy white; apothecia long and narrow, $1-4 \times 0.2-0.3$ mm., semi-superficial, curved or flexuous, often

branched, sometimes radiately, the disk soon open, flat, dull black, the exciple rather thin and black; hypothecium and hymenium pale; paraphyses hyaline, branched, interwoven, and semi-distinct; asci broadly clavate, the wall not much thickened in the apical region; spores 8, long-elliptic, hyaline to finally pale brownish, 5-7-septate, the cells cylindric, $17-23 \times 4.5-5 \mu$, irregularly arranged.

On bark in an open field near Rio Piedras, Fink 507.

MELASPILEA Nyl.

1. *Melaspilea cinereoatra* n. sp.

Thallus very thin or superficially absent and the imbedded portion giving the substratum an ashy gray surface coloration; apothecia short and very narrow, $0.4-1.3 \times 0.15-0.2$ mm., superficial and scattered, straight to less frequently curved, very rarely branched, the disk closed and indicated by an inconspicuous, depressed, black line, the black exciple moderately thick; hypothecium rather thick, brownish black; hymenium pale; paraphyses hyaline, unbranched, distinct to finally indistinct; asci oblong-clavate, becoming somewhat ventricose, the wall scarcely thickened in the apical region; spores 8, oblong, hyaline to pale brown, 1-septate with one cell slightly larger, $22-24 \times 7.5-8.5 \mu$, irregularly arranged.

On bark on a high, dry hilltop near Yauco, Fink 1475.

2. *Melaspilea cryptothallina* n. sp.

Thallus wholly imbedded in the substratum and showing at the surface as an ashy gray coloration; apothecia short and very narrow, $0.4-1.6 \times 0.1-0.15$ mm., adnate, commonly scattered, straight to curved or obscurely flexuous, rarely branched, the disk closed and sometimes indicated by a depressed, black line, the exciple thin and black; hypothecium and hymenium hyaline; paraphyses hyaline, unbranched, becoming indistinct; asci clavate, the wall scarcely thickened in the apical region; spores 8, oblong, 1-septate with one cell usually larger, passing from hyaline to pale brown, $15-17 \times 7-8 \mu$, irregularly arranged.

On bark on a hilltop near Yauco, Fink 1557, and in a wood near Manati, Fink 2056 (type). Algal host infrequently seen with the lichen hyphae within the substratum.

3. *Melaspilea fuscolimitata* n. sp.

Thallus imbedded in the substratum and indicated at the surface by an olive-gray to ashy coloration and a blackish

limiting line; apothecia moderately long but narrow, $0.5\text{--}2.5 \times 0.15\text{--}0.25$ mm., adnate and often clustered, straight to curved or flexuous, infrequently once to several times branched, the disk closed and indicated by an obscure, depressed, black line, the exciple black and moderately thick; hypothecium and hymenium hyaline; paraphyses hyaline, unbranched, and semi-distinct; asci clavate, with the wall slightly thickened in the apical region; spores 8, oblong, 1-septate, constricted with one cell larger, hyaline to finally brown, $12\text{--}16 \times 6\text{--}8 \mu$, irregularly arranged.

On bark on a high, exposed hilltop near Yauco, Fink 1480 (type) and 1622.

4. *Melaspilea subolivacea* n. sp.

Thallus imbedded in the substratum and showing at the surface as a dull olive-brown coloration; apothecia short to long but narrow, $1\text{--}4 \times 0.15\text{--}0.3$ mm., adnate and scattered, straight to curved or rarely and obscurely flexuous, very infrequently branched, the disk closed and indicated by a depressed, black line, or more or less open and brownish black or slightly tinged with red, the exciple black, of moderate thickness; hypothecium and hymenium pale, the former often subtended by a blackish portion of the perithecial wall; paraphyses hyaline, unbranched, and semi-distinct; asci clavate, the wall but little thickened in the apical region; spores 8, soon pale brown, oblong, 1-septate, constricted, with one cell usually larger, $23\text{--}27 \times 10\text{--}12 \mu$, irregularly arranged.

On bark in a wood near Aibonito, Fink 1810. Algal host occasionally seen with the lichen hyphae.

5. *Melaspilea subrimalis* n. sp.

Thallus thin and smooth, light greenish gray to yellowish ashy, the superficial portion often absent; apothecia long and narrow, $1\text{--}4 \times 0.15\text{--}0.3$ mm., adnate, numerous and often clustered, straight to variously curved, very rarely branched, the disk closed to narrowly open and black, the exciple of the same color and moderately thick; hypothecium blackish brown; hymenium hyaline or pale; paraphyses hyaline, distinct, and unbranched; asci oblong-clavate, with the wall slightly thickened in the apical region; spores 8, oblong, 1-septate, slightly constricted, with cells equal, hyaline to finally dark brown, $15\text{--}19 \times 7\text{--}9 \mu$, irregularly arranged.

On bark in an open field near Manati, Fink 2035.

GRAPHIS Adans.

1. *Graphis dumastioides* n. sp.

Thallus thin, smooth, pale olive-brown, varying toward greenish gray; apothecia short and narrow, $0.5-2 \times 0.15-0.25$ mm., immersed, unbranched, straight to curved, the disk closed and finally indicated by a raised to depressed, dark line, the exciple pale and rudimentary, covered by a light colored, thalloid one; hypothecium and hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci cylindroclavate, the wall only moderately thickened in the apical region; spores 8, hyaline, oblong-elliptic, 3-septate, the cells lenticular, $14-18 \times 6-8 \mu$, obliquely uniseriate.

On bark in a wood near Mameyes, Fink 723.

2. *Graphis rimulosa lignicola* n. subsp.

Thallus thin, smooth, ashy white; apothecia becoming long and wide, $1-7 \times 0.3-0.4$ mm., immersed to semi-superficial, unbranched, mostly straight and roughly parallel, the last two constituting the distinctive subspecific characters, the disk closed and indicated by a depressed, black line, the exciple black and becoming two or three times longitudinally striate; hypothecium and hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci broadly clavate, plainly thickened in the apical region; spores reaching 8, hyaline, long-elliptic, 9-14-septate, the cells lenticular, $30-40 \times 6.5-8.5 \mu$, irregularly arranged.

On decorticated wood in an open field near Aibonito, Fink 1873.

3. *Graphis yaucoensis* n. sp.

Thallus rather thin, smooth, ashy gray, becoming sparingly chunky; apothecia very long and very narrow, $2-8 \times 0.12-0.18$ mm., partly immersed, soon and often strongly curved or flexuous, very rarely branched, the disk closed to narrowly open, indicated by a black line or showing a narrow or wider, grayish, flat surface, the exciple brownish black, moderately thick, surrounded more or less by a thin, ashy gray, thalloid one; hypothecium pale to darker brown, sometimes tinged with red; hymenium hyaline; paraphyses hyaline, semi-distinct, and unbranched; asci clavate, the wall moderately thickened in the apical region; spores 8, hyaline, long-elliptic, 5-9-septate, the cells lenticular, $26-32 \times 5.5-6.5 \mu$, irregularly arranged.

On bark in a wood near Yauco, Fink 1691.

4. *Graphis albida* n. sp.

Thallus rather thin, smooth to slightly rough, grayish white or tinged with yellow; apothecia long and wide, $1-4 \times 0.3-0.4$ mm., partly immersed to adnate, and completely covered by a thin, whitish, thalloid veil, straight to curved or flexuous, infrequently once to five times branched, in the several-branched conditions often more or less plainly radiate, the disk closed and indicated by a dark line when moistened, the exciple and the hypothecium brownish black; hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci clavate, the wall but slightly thickened in the apical region; spores reaching 8, hyaline, elliptic, 3-7- but usually 5-septate, cells lenticular and the end cells larger, $16-28 \times 7.5-10 \mu$, irregularly arranged.

On bark in an open field near Aibonito, Fink 1777.

5. *Graphis immersa* n. sp.

Thallus of moderate thickness, smooth, ashy white; apothecia becoming long but remaining narrow, $1-4 \times 0.2-0.25$ mm., immersed to slightly raised, straight to curved or flexuous, infrequently once branched, the disk closed and indicated by an obscure, depressed, black line, the exciple black, thickish and once or twice obscurely striate longitudinally, when raised bordered more or less by a whitish, thalloid one; hypothecium thick and brownish black; hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci clavate to broadly clavate, the wall much thickened in the apical region; spores 8, hyaline, long-elliptic, 7-13-septate, the cells lenticular, $22-45 \times 7.5-8.5 \mu$, irregularly arranged.

On bark on a high, exposed hilltop near Yauco, Fink 1613.

6. *Graphis tumidulella* n. sp.

Thallus of moderate thickness, smooth to slightly rough, becoming obscurely chinky, pale greenish gray to ashy; apothecia long and rather narrow, $1.5-7 \times 0.25-0.35$ mm., slightly immersed to adnate, more or less curved or flexuous, very rarely branched, the disk closed and indicated by a depressed, dull black line, or narrowly open and black, the exciple thin above to thick below, black and covered by a strongly developed, whitish, thalloid one; hypothecium brownish black; hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci clavate, the wall moderately thickened in the apical region; spores 8, hyaline, long-elliptic, 9-12-septate, the cells lenticular, $35-53 \times 7-9 \mu$, irregularly arranged.

On bark in a wood near Aibonito, Fink 1737 (type). Also in the foothills of El Yunque, Percy Wilson 19, collected in 1902.

PHAEOGRAPHIS Müll. Arg.

1. *Phaeographis sexloculata* n. sp.

Thallus thin or entirely within the substratum and indicated by an ashy to olivaceous coloration; apothecia long but remaining very narrow, $1-3.5 \times 0.15-0.2$ mm., partly immersed, usually curved or flexuous, unbranched, the disk closed and indicated by a depressed, blackish line, the exciple black and rather thin; hypothecium and hymenium hyaline; paraphyses hyaline, unbranched, becoming indistinct in the finally granular matrix; asci clavate, the walls moderately thickened in the apical region; spores 8, oblong, pale to darker brown, 5-septate, the cells lenticular, $22-26 \times 8-9 \mu$, irregularly arranged.

On bark on an exposed hilltop near Yauco, Fink 1436.

2. *Phaeographis inustoides* n. sp.

Thallus rather thin and smooth, pale greenish gray to whitish; apothecia round to short and wide, 0.3-0.6 mm. across, or elongated in one direction to 1.5 mm. and straight to curved, wholly immersed, the disk open and black, slightly concave to flat, the exciple thin and dark brown, surrounded by a thin, whitish, thalloid one; hypothecium and hymenium hyaline; paraphyses hyaline, unbranched, becoming indistinct; asci clavate, the wall more or less thickened in the apical region; spores 8, hyaline to brown, oblong to oblong-elliptic, or acute toward one end and larger and rounded toward the other, 5-, rarely 7-septate, the cells lenticular, $19-22 \times 7-9 \mu$, irregularly arranged.

On bark on dry slopes near Cabo Rojo, A. A. Heller 4430 (type), collected in 1900. Also collected by Heller near Bayamon, 1251 and 1252, in 1899, and near Vega Baja, 1329, in 1900.

GRAPHINA Müll. Arg.

1. *Graphina aibonitensis* n. sp.

Thallus thin, smooth, light greenish gray to ashy; apothecia becoming very long but remaining narrow, $1-10 \times 0.18-0.3$ mm., immersed to semi-superficial, numerous and irregularly or radiately arranged, commonly curved or flexuous, the short ones unbranched, the longer ones once to several times branched, the radial arrangement seen toward the margins of thalli, the

disk soon open and brown or obscurely whitish pruinose, the exciple rudimentary, thin and brownish, covered by a well-developed, ashy, thalloid one; hypothecium hyaline to brownish; hymenium hyaline; paraphyses hyaline, semi-distinct, and unbranched; asci cylindroclavate to clavate, the wall moderately thickened in the apical region; spores 8, hyaline, oblong-elliptic, muriform, 3-5-septate transversely and 1-septate longitudinally toward the center, $10-12 \times 4-5 \mu$, uniseriately to irregularly arranged.

On bark in an open wood near Aibonito, Fink 1998 and 2017 (type).

2. *Graphina cinerea* n. sp.

Thallus thin, smooth, pale greenish gray to ashy; apothecia long and very narrow, $1-4 \times 0.1-0.15$ mm., immersed, becoming strongly curved or flexuous, once to three or more times branched, the disk and the exciple covered by a thalloid veil, the former closed and indicated by a thin, black line when moistened, the latter thin, brownish and sometimes not distinguishable; hypothecium and hymenium hyaline, or the former tinged with brown; paraphyses hyaline, semi-distinct, and unbranched; asci clavate, the wall moderately thickened in the apical region; spores 8, hyaline, elliptic, muriform, 3- more commonly 5-septate transversely and becoming 1-2-septate longitudinally, $13-16 \times 5-6 \mu$, irregularly arranged.

On bark in an open field near Mayaguez, Fink 1163.

3. *Graphina olivaceoalbida* n. sp.

Thallus thin and smooth, dull olive-colored, except for the whitish areas covering the apothecia, the superficial portion sometimes disappearing; apothecia moderately long but narrow, $1-3 \times 0.2-0.3$ mm., partly immersed to adnate, unbranched, straight to slightly curved, the disk closed and indicated by a dark line or more or less open, depressed, and pale brownish, the exciple thin and rudimentary, pale toward the base and brownish above; hypothecium and hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci clavate, the wall moderately thickened in the apical region; spores 4 or more, hyaline, oblong-elliptic, muriform, 5-9-septate transversely and 1-2-septate longitudinally, $19-24 \times 9-10 \mu$, irregularly arranged.

On bark in a wood near Mameyes, Fink 815.

4. *Graphina olivobrunea* n. sp.

Thallus thin, smooth, light olive-brown; apothecia of moderate length and very narrow, $0.5-3.5 \times 0.08-0.12$ mm., partly

immersed, variously curved or flexuous, often once or more times branched, becoming much interwoven, the disk closed and covered by a thalloid veil to emergent and indicated by a pale brownish line, or rarely opening narrowly when concave and pale, the exciple pale brownish, thin and rudimentary, surrounded by a thin, olive-brown, thalloid one; hypothecium and hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci clavate, the wall more or less thickened in the apical region; spores 4 or more, hyaline, oblong-elliptic, muriform, 5-7-septate transversely and 1-2-septate longitudinally, $19-29 \times 8.5-10.5 \mu$, irregularly arranged.

On bark in a wood near Mayaguez, Fink 1224.

5. *Graphina sulcata* n. sp.

Thallus thin, smooth, pale greenish gray to ashy white; apothecia long and narrow, $1-5 \times 0.2-0.32$ mm., immersed to semi-superficial, straight to curved or flexuous, infrequently becoming once to two or three times branched, the disk closed and indicated by a depressed, black line, the exciple black and of moderate thickness, becoming once striate longitudinally, covered laterally by a whitish and disappearing, thalloid one; hypothecium and hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci clavate, the wall not much thickened in the apical region; spores 2-4, hyaline, oblong-ovoid, muriform, 5-7-septate transversely and 2-4-septate longitudinally, $20-30 \times 10-14 \mu$, irregularly arranged.

On bark in a wood near Rio Piedras, Fink 659.

6. *Graphina riopiedrensis* n. sp.

Thallus moderately thick, smooth or rarely and obscurely scurfy granulose, ashy gray; apothecia long and very narrow, $1-4 \times 0.15-0.2$ mm., partly immersed, variously curved or flexuous, rarely once to two or three times branched, the disk closed and indicated by a depressed, blackish line or opening narrowly when more or less concave and brownish black, the exciple thin throughout or thicker above and very thin or absent below, appearing brownish black where thicker to brown where thinner, covered laterally by an ashy gray, thalloid one; hypothecium and hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci clavate to broadly clavate, the wall much thickened in the apical region; spores 8, hyaline, oblong-elliptic, muriform, 7-9-septate transversely and 2-3-septate longitudinally, $17-34 \times 8-16 \mu$, irregularly arranged.

On bark in a wood near Rio Piedras, Fink 2167.

7. *Graphina nitidescentoides* n. sp.

Thallus thin, smooth, varying from ashy white to olivaceous, usually the former color about the apothecia, often disappearing above the substratum; apothecia short and narrow, $0.5\text{--}1 \times 0.17\text{--}0.23$ mm., semi-superficial, scattered or rarely clustered, straight to rarely curved, unbranched, the disk closed and indicated by an obscure, depressed line to open, concave, and dull brown, the exciple thin and brown; hypothecium and hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci clavate, the wall moderately thickened in the apical region; spores 8, hyaline, oblong-elliptic, muriform, 5–9-septate transversely and 1–2-septate longitudinally, $19\text{--}23 \times 7.5\text{--}8.5$ μ , uniseriately to irregularly arranged.

On bark in a wood near Rio Piedras, Fink 521

8. *Graphina luridoolivacea* n. sp.

Thallus thick, smooth and warty, greenish gray or tinged with yellow or brown; apothecia short and very narrow, $0.5\text{--}1 \times 0.1\text{--}0.15$ mm., immersed, scattered or clustered, rarely branched, the disk closed and indicated by a yellowish line, or open, concave, and yellowish to brownish, the exciple very thin and yellowish, or disappearing; hypothecium and hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci clavate or enlarged below, the wall thickened in the apical region; spores 8, hyaline, oblong-elliptic, muriform, 7–9-septate transversely and 1–3-septate longitudinally, $18\text{--}27 \times 9\text{--}12$ μ , irregularly arranged.

On bark in a wood near Rio Piedras, Fink 657.

9. *Graphina elongatoradians* n. sp.

Thallus moderately thick, smooth, ashy gray; apothecia very long and very narrow, $8\text{--}20 \times 0.12\text{--}0.2$ mm., semi-superficial, radiately arranged and subdichotomously branched, the disk closed and indicated by an obscurely depressed, blackish line, the exciple black, of medium thickness, finally becoming obscurely once striate longitudinally, covered more or less laterally by a grayish, thalloid one; hypothecium and hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci clavate, the wall moderately thickened in the apical region; spores 4 or more, hyaline, oblong, muriform, 7–9-septate transversely and 1–3-septate longitudinally, $35\text{--}45 \times 13\text{--}15$ μ , irregularly arranged.

On bark in an open field near Manati, Fink 2049.

10. *Graphina vestitoides* n. sp.

Thallus thin to moderately thick, smooth to minutely rough, greenish gray varying toward ashy; apothecia very long and

very wide, $2-10 \times 0.4-0.7$ mm., partly immersed, numerous but usually scattered, more or less curved or flexuous, very rarely branched, the disk closed and usually indicated by a depressed, blackish line, the exciple thick, black, plainly once or twice striate longitudinally, wholly or partly covered by a grayish, finally disappearing, thalloid one; hypothecium thick and brownish black; hymenium hyaline; paraphyses hyaline, unbranched, distinct to semi-distinct; asci large and clavate to inflated-clavate, the wall considerably thickened in the apical region; spores reaching 8, hyaline, long-elliptic, muriform toward the ends or rarely throughout, 14-27-septate transversely and becoming 1-2-septate longitudinally, $85-140 \times 12-18 \mu$, irregularly arranged, but sometimes tending toward parallel arrangement.

On bark in various habitats throughout the Island, Fink 148, 152, 215, 708, 948, 1795, 1906, and 1986 (type).

11. *Graphina platycarpa* n. sp.

Thallus moderately thick, smooth, becoming chinky to finally chinky-areolate, ashy gray to yellowish; apothecia long and very wide, $1-4 \times 0.5-1.2$ mm., partly immersed, straight to occasionally curved or obscurely flexuous, sometimes once or more times shortly branched, the disk open, flat, and black, the brownish black exciple rather thin and surrounded by a grayish to yellowish, thalloid one; hypothecium like the exciple in thickness and color; paraphyses and the whole hymenium hyaline, the former semi-distinct and unbranched; asci clavate, the wall thickened considerably in the apical region; spores 1 or rarely 2, hyaline to finally brownish, oblong to oblong-elliptic, muriform, 23-37-septate transversely and 5-9-septate longitudinally, $130-165 \times 30-36 \mu$.

On bark in a wood near Aibonito, Fink 1774.

PHAEOGRAPHINA Müll. Arg.

1. *Phaeographina asteroides* n. sp.

Thallus very thin and smooth, olivaceous or showing more or less of greenish gray in younger conditions, often disappearing above the substratum and indicated by surface coloration; apothecia becoming long and wide, $0.5-4 \times 0.18-0.45$ mm., slightly immersed to adnate, often clustered, straight to curved, commonly more or less branched, the grouping and branching often giving more or less of a stellate appearance, the disk soon open, dark brown to blackish, or whitish pruinose, the exciple

very thin, brownish black, often bordered more or less laterally by an olivaceous or lighter colored, thalloid one; hypothecium, hymenium and paraphyses hyaline, the last distinct to semi-distinct, and unbranched; asci cylindric to clavate, the wall moderately thickened in the apical region; spores 8, brown, oblong-elliptic, muriform, 4-6-septate transversely and 1-2-septate longitudinally, $23-28 \times 8-12 \mu$, uniseriately to biseriately and finally irregularly arranged.

On bark in an open field near Mayaguez, Fink 981.

2. *Phaeographina caesiopruinosella* n. sp.

Thallus very thin and smooth, light olivaceous or tinged with greenish gray in earlier conditions, the superficial portion disappearing and the thallus indicated by surface coloration; apothecia becoming moderately long and wide, $0.6-3 \times 0.25-0.45$ mm., immersed to semi-superficial, more or less curved or flexuous, numerous and closely clustered, usually once to four times branched, the disk open, flat, and grayish pruinose, the exciple thin and brown, often bordered obscurely by a grayish, thalloid one; hypothecium hyaline to brownish; hymenium hyaline; paraphyses hyaline, distinct to semi-distinct, and unbranched; asci clavate to finally saccate, the wall much thickened in the apical region; spores 8, brown, oblong to oblong-elliptic, muriform, 5-9-septate transversely and becoming 1-2-septate longitudinally, $25-45 \times 12-18 \mu$, irregularly arranged.

On bark in woods near Rio Piedras, Fink 42 and 140 (type).

3. *Phaeographina difformis* n. sp.

Thallus very thin, smooth and pale greenish gray; apothecia roundish to irregular or elongated, 0.5-0.8 mm. across or elongated in one direction to 1 or 1.4 mm., partly immersed, scattered or clustered, rarely and shortly branched, the disk open and brownish black, the exciple thin and of the same color, covered wholly or in part by a greenish gray, thalloid one; hypothecium thin and dark brown; hymenium hyaline; paraphyses hyaline, unbranched, imbedded in a granular matrix and semi-distinct; asci becoming broadly clavate, the wall considerably thickened in the apical region; spores 8, brown, oblong-elliptic, muriform, 7-11-septate transversely and 1-2-septate longitudinally, $30-48 \times 10-15 \mu$, irregularly arranged.

On posts in an open field near Aibonito, Fink 1874.

4. *Phaeographina nitidescens* n. sp.

Thallus thin and smooth, lustrous greenish gray to light olivaceous; apothecia short and narrow, $0.5-2.5 \times 0.15-0.25$ mm., immersed and seen with difficulty, scattered or rarely clustered, straight to curved, very rarely branched, the disk closed and indicated by a line or finally and narrowly open and concave, the exciple rudimentary or absent, the apothecial structures covered by the thallus; hypothecium and hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci broadly clavate, the wall moderately thickened in the apical region; spores 1, hyaline to brown, oblong to oblong-elliptic, muriform, 27-39-septate transversely and 5-9-septate longitudinally, $70-110 \times 20-35 \mu$.

On bark in wooded areas of El Yunque at 2200 ft., Fink 724.

5. *Phaeographina scalpturata distorta* n. subsp.

Apothecia short, becoming variously distorted, the thalloid exciple becoming strongly developed and showing an irregularly incurved margin, partly or wholly covering the disk; spores 1 or 2, brown, oblong-elliptic, muriform, 18-59-septate transversely and 9-17-septate longitudinally, $60-200 \times 15-50 \mu$.

On bark in woods near Aibonito, Fink 1808 and 1900 (type).

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THE PERFECT STAGE OF HENDERSONIA MALI¹

L. R. HESLER

A few years ago apple twigs bearing the fungus *Hendersonia Mali* Thümen were collected at Hemlock Lake, New York. Accompanying this conidial form were perithecia, asci and ascospores characteristic of the genus *Pleospora*. When cultures of ascospores were made the resulting growth yielded *Hendersonia* conidia which agreed morphologically with those noted on the apple twigs. Further study of the ascomycete has proved that the fungus is a new species.

Perithecia were removed to a sterile drop of water in a sterile petri dish. Further procedure ensued along one of two general lines: (1) by means of a capillary pipette (as previously described, Hesler 1913: 291-292) a single ascospore was removed either (a) to a drop of sterile water in another sterile petri dish into which warm potato agar was then poured, or (b) to a hard potato agar plate prepared in advance; (2) warm potato agar was poured into a dish in which ascospores had been placed. When the dish and contents were cooled single ascospores were marked for further study.

Under conditions described above ascospores germinated within a few (8-12) hours, and pycnidia bearing pycnospores were matured within six days. A number of sowings were made to learn the genetic connection, if any, between the ascomycete and *Hendersonia Mali* Thüm.

After concluding that such connection did exist, apple twigs on young trees in the field were inoculated on different occasions in the months of June and July (1915). In each case no evidence of pathogenic action could be detected. The fungus apparently died and the incisions (prepared to serve as infection-courts) healed. Scott and Quaintance (1907) call attention to the

¹ The writer is indebted to Dr. H. M. Fitzpatrick, Cornell University for counsel in this investigation.

prominence of *Hendersonia* among several fungi associated with apple leaf spots, but they are not clear as to its parasitism. Scott and Rorer (1908) inoculated apple leaves with *Hendersonia* conidia but negative results were obtained. They concluded that the organism was probably saprophytic. Lewis (1912) isolated *Coryneum foliicolum* Fuckel from apple leaves in Maine. He made inoculations on leaves finding that the fungus grew and fruited on dead areas of leaf tissue but formed no new lesions. The possibility that this fungus might be confused with *Hendersonia* has been pointed out by Hall (1915).

It appears that, according to the cases noted above, *Hendersonia Mali* Thüm. is saprophytic on apple leaves and twigs. The common occurrence of the fungus on apple, however, occasions some interest. Further study may reveal a pathological angle not now evident.

Host indices available do not list a species of *Pleospora* on apple. After preliminary study of Saccardo's descriptions all forms were eliminated from consideration except *Pleospora aculeorum* Berl. On examination of Berlese's Monografia (1888) an additional species, *Pleospora Principis* Passer., appeared related to the fungus on apple. Attempts to locate in the United States exsiccati of these and other species of *Pleospora* suspected of being closely related to the apple fungus were unsuccessful. On request, Professor O. Mattirola, Torino, Italy, sent from Passerini's collection a fragment of *Phoenix dactylifera* bearing perithecia of *Pleospora Principis* Passer. He sent also a specimen labelled *Pleospora aculeorum* Berl. but the perithecia bore no asci nor ascospores. After making a study of the material sent by Mattirola, it is evident that the fungus on apple is different from *Pleospora Principis* Passer. From the figures and descriptions of Berlese it appears that the apple fungus is also distinct from *Pleospora aculeorum* Berl. Therefore the apple fungus is a new species and is herewith described as follows:

Pleospora Mali n. sp.

Perithecia scattered, small, $144 \times 178 \mu$ (horizontal by vertical), range $121-170 \times 154-195 \mu$, black, covered, without a subiculum, ostiolum broadly conical; asci clavate or cylindrical-clavate, rounded at upper end, rather short stalked, $16.7 \times 98.4 \mu$,

range $16-18 \times 93-110 \mu$; ascospores irregularly or obliquely uniseriate at the base and upper end, sometimes biseriate between, $9 \times 19 \mu$, range $8-10 \times 15.8-22.3 \mu$, constricted at the middle, rounded on both sides, mostly obtusely-conical tip, few with rounded tip, gelatinous sheath not evident, mostly 5-7-septate, primary transverse septa thicker than others, the two to four or more middle cells once, rarely twice, longitudinally divided, yellowish at first, becoming brown at maturity; paraphyses slender, longer than the asci.

Habitat: In bark of dead apple twigs, Hemlock Lake, N. Y.

According to Berlese's *Monografia* (1888) the genus *Pleospora*, which was established in 1857 by Rabenhorst, is divided into groups on a basis of number of transverse septations in the ascospores. The fungus on apple falls into Berlese's group D—species with spores transversely 6-7-septate, one to three cells longitudinally divided, spores pleosporaceous, $20-35 \mu$, perithecia membranaceous.

The ascospores of the apple fungus are described above as transversely 5-7-septate. Approximately 4 per cent are 4-septate, 46 per cent 5-septate, 37 per cent 6-septate, 13 per cent 7-septate. The majority of the spores, it is seen, are five- and six-septate, although seven-septate spores are in sufficient numbers to attract attention. Very often the three or four middle septa are noticeably of greater thickness than those at the ends of the spore. In some cases the transverse end septa are indistinct. Occasionally a transverse septum extends but half-way across the spore, joining with the longitudinal wall of that cell. Longitudinal septa passing through all cells are uncommon, although the three or four middle cells are frequently so divided. Occasionally a cell shows two longitudinal septa. The end cells are sometimes longitudinally divided. Occasionally in the end cell a longitudinal and an obliquely transverse septum join in a Y-shaped fashion.

The younger ascospores are yellowish. At maturity they are brown. The heavy primary, middle septa intensify the color effect of the whole spore.

Another character of the ascospores is the relative size of the upper and lower portions as they lie in the ascus. Most of the spores are broader in their upper portions than they are in their

lower. Not infrequently there is a distinct bulge about midway between the constriction and the upper end. Usually the upper portion has also a slightly greater longitudinal dimension than the lower.

The asci are typically 8-spored. One ascus was found with but seven spores, another with six. Almost invariably the basal spore occurs alone, lying lengthwise or obliquely. The other spores are arranged biserially, or uniserially, or in a manner combining these two types of arrangements. A complete biserial arrangement of ascospores in the ascus was not observed.

The perithecia of *Pleospora Mali* are scattered and relatively few in number on the material collected. Since only one collection has been made by the writer it is probable that the perithecial stage of *Hendersonia Mali* Thüm. is rare. Reports of its occurrence elsewhere are lacking. It is recalled, in this connection, that in the northern latitudes the perithecial form of *Sphaeropsis malorum* Berk. (*Physalospora Cydoniae* Arnaud) does not develop abundantly (Hesler, 1916). On the other hand it is frequently found in the South. Whether *Pleospora Mali* is likewise more common in southern states is not known; casual search made thus far, however, indicates that it is rare.

From the beginning it has been evident that *Pleospora Mali* is closely related to *Pleospora aculeorum* Berlese and *Pleospora Principis* Passer. Whether or not the apple fungus was the same as one of these two latter species was the question to be determined. From an examination of Berlese's Icones (1895), his Monografia (1888), Saccardo's descriptions in Sylloge (1891), and specimens of *Pleospora Principis* Passerini, sent by Professor O. Mattirola, it is certain that there are important differences sufficient to distinguish all three forms.

While admittedly there is a resemblance of *Pleospora Mali* to *Pleospora Principis* through size and color of perithecia, absence of a subiculum, septation and color of spores, there are noticeable dissimilarities in size and shape of the asci and ascospores. The asci of *Pleospora Principis* are broader and more bag-like than those of *Pleospora Mali*. The ascospores are rounded and subattenuated in *Pleospora Principis* while in *Pleospora Mali* few have rounded ends; most of the spores possess obtusely-

conical tips. The spores are larger in *Principis* than in *Mali*; about $5\ \mu$ to $6\ \mu$ longer and slightly broader. Paraphyses are not mentioned, nor figured, in Berlese's works (1888; 1895). In material of *Pl. Principis* from Italy examined by the writer there was clearly no indication of paraphyses. Probably a new species in this group of fungi should not be recognized on the basis of this character alone. Little is known of the constancy of this character; paraphyses are not always distinct in a species in which these structures certainly occur. The morphology of the asci and ascospores however clearly separates *Pleospora Mali* from *Pleospora Principis* Passer.

Pleospora Mali is more nearly like *Pleospora aculeorum* than *P. Principis*. This resemblance is found in the character of the asci, ascospores and paraphyses. The form of the asci is similar and the size and septation of the ascospores are approximately the same in *aculeorum* and *Mali*. Striking differences, on the other hand, lie in the morphology of the perithecia, and in certain characters of the ascospores. The perithecia of *P. Mali* are noticeably smaller ($50\text{--}75\ \mu$) than those of *P. aculeorum*. The latter fungus has a subiculum which is distinctly absent in *P. Mali*. Probably this character alone under certain conditions is sufficient to justify separation of the two species. There are, however, important differences which clearly separate the two forms. The ascospores of *P. Mali* are more consistently constricted at the middle than those of *P. aculeorum* Berlese. The ends of the ascospores are obtusely conical in *Mali* and rounded in *aculeorum*. A striking difference between the two species is found also in the color of the ascospores; the spores of both forms are yellowish when young, but at maturity those of *P. Mali* are brown while those of *P. aculeorum* Berl. are olivaceous, or yellow-olivaceous.

In spite of the fact that *Pleospora Mali* is saprophytic, its occurrence on a substratum which is very different from that of *P. aculeorum* (on rose) and *P. Principis* (on date) should also have some weight. In the absence of nutritional studies, the separation of these forms must rest on a basis of their morphology.

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NOTES AND BRIEF ARTICLES

Dr. James R. Weir, pathologist in charge of the office of Mycological Collections, Bureau of Plant Industry of Washington, and who was for several years consulting pathologist for the Bureau with the U. S. Forest Service in the Northwest, has been appointed pathologist for "The Rubber Research Institute of Malaya" at Kuala Lumpur, Federated Malay States. Dr. Weir sailed for the Orient sometime in April.

FLESHY FUNGI

The cool moist season of 1926 in southern Ontario accompanied if it did not cause unusual conditions of the fleshy fungi crop. Veteran mycophagists are asking one another: Do you ever remember a year before this one when you could not find a single meadow-mushroom? The smooth lepiote, *Lepiota naucina*, usually locally abundant in September, was equally well hidden.

On the other hand certain Amanitae, Hygrophori, Cortinari, Tricholomata and Boleti were unusually large and abundant. Large Psalliotae—*subrufescens*, *abruptibulba*, *arvensis*, etc.—made up for the scarcity of *campestris*. Parasol mushrooms over a foot high—one dried example is now 34 cm.—growing in a shady grove the last week of September reminded me of the illustrations of imagined scenes in John Uri Lloyd's Etidorhpa. I have to go back in my notes thirty years to find a record of *Amanita muscaria* approaching in size and brilliance of color several that I saw this year. Some American writers question that we have the brilliant scarlet forms of that plant which European artists find and love to paint, but some of these fly agarics were as brilliant in color as any plate of them that I have seen. The largest one of two or three dozen that I observed on Oct. 4th, on less than an acre of mixed woodland, was 23 cm. tall and measured 18 cm. over the pileus which was 6 cm. across the strong blood-red center, lightening out by indefinite zones to the rich orange margin. The gills were pure white; the under

side of the ample annulus and the stem below it were yellow. I think it was the most attractive agaric that I ever saw.

In Essex Co., *Lepiota Morgani* had to its account at least one poisoning serious enough or frightening enough to involve a physician's services. Professor G. R. Bisby informs me that he has a photograph of a 1926 specimen of *Agaricus arvensis* that measured 13 inches across the cap and weighed 4 lbs. 5 oz. It was, however, found in Alberta.

JOHN DEARNESS

THE YELLOW-GILLED RUSSULA

During the summer, when most species of *Russula* are fruiting, insects are so abundant and the plants so scattered that the mycophagist cannot depend very much upon them for his table. But I have found the yellow-gilled species very satisfactory, both in Virginia and northern Florida, for several reasons. It appears in the fall when the cool weather keeps the insects in check; it grows gregariously and appears abundantly in the open pine woods, coming up under the masses of needles, sometimes half a dozen or more together; and all parts of the hymenophore, including the tender, fleshy stem, are edible.

During the latter part of October, it was abundant about Lynchburg, Virginia, while at Gainesville, Florida, I collected it frequently toward the end of November and later for my table. The species is a pretty one and readily recognized among the red species of the genus by its distinctly yellow gills. When very young they are white like those of *R. emetica*, but they very soon become yellow and there is no reason to confuse the two species.

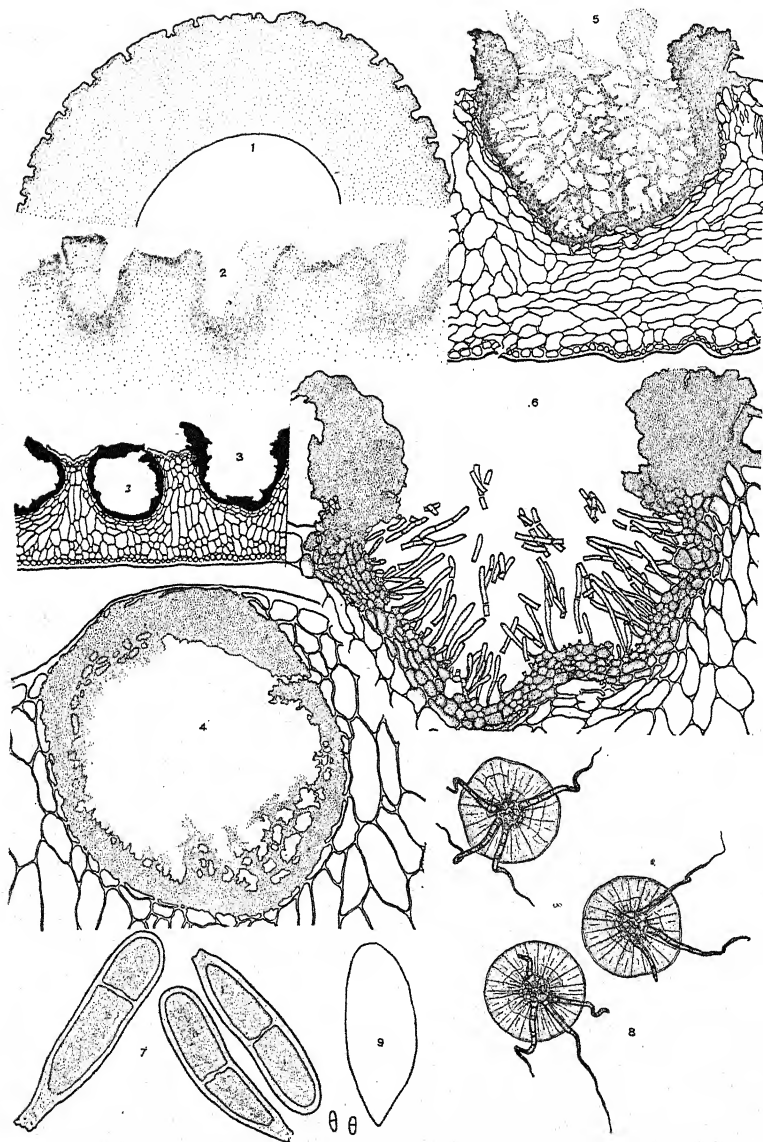
In cooking the yellow-gilled *Russula*, I simply cut off the base of the stem; wash off adhering bits of dirt and trash; cut into halves or quarters according to size; and boil in a little water with salt for five or ten minutes until thoroughly soft. Evaporated milk and a dash of black pepper make excellent seasoning. Serve on buttered toast.

The autumn in Florida was quite dry and few fleshy fungi were found in November. On November 27, however, I collected enough for a mess by mixing *Pluteus cervinus*, *Lactaria Indigo*,

Lactaria laccata, *Hygrophorus miniatus*, a species of *Helvella*, and the yellow-gilled *Russula*. On the following day, I found a quantity of the last species in a little pine grove and used it alone. The squirrels here are very fond of this species.

W. A. MURRILL

GAINESVILLE, FLORIDA,
November 29, 1926



SHROPSHIRIA AND CLYPEODIPLODINA

MYCOLOGIA

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NEW TROPICAL FUNGI

F. L. STEVENS

(WITH PLATES 18-21)

Shropshiria Stevens, gen. nov.

Sori on the periphery of sclerotoid stromata, open, bordered by sterile peridia; conidiophores long, simple, bearing the conidia laterally. Conidia 1-celled, globose, smoky.

Named in honor of Mr. J. B. Shropshire in recognition of his helpful interest in the biologic sciences in the Panama Canal Zone.

Shropshiria Chusqueae Stevens, sp. nov.

Sporiferous stromata caulicolous, globose, or subglobose to irregularly oblong, brown to gray or black, 3-8 mm. in diameter, roughened over the entire surface by the projecting spore columns. Sporogenous cups about 150-180 μ wide at the open mouth, about 230 μ deep, and dark bordered on sides and bottom. Sterile space between cups 150-230 μ . The rind between the sori in surface view, microscopically, is light brown in color and made up of cells of quite uniform size, about 3-4 μ in diameter and having a pseudo-parenchymoid appearance. Conidiophores arising from the brown base of the cup, hyaline, parallel and straight, slender, simple, septate, about 2 μ thick, 250 μ long. The spores are borne laterally on the distal ends of the conidiophores. Conidia smoky, globose, dark in mass, 3 μ in diameter.

On *Chusquea simpliciflora*.

Panama. Brazos Brook reservoir, 9-22-1924. No. 697 (type); Culebra, 10-2-1924. No. 939; Las Cruces trail, 9-28-1924. No. 876.

The sclerotoid stromata always develop laterally on the stem of the bamboo and remain lateral, *i.e.*, they do not encircle them.

[MYCOLOGIA for July-August (19: 153-230) was issued July 1, 1927]

In young specimens they are smooth and brown, but as they become sporogenous they are thickly beset with the sori, which to the naked eye are gray in their centers, and thus the whole stroma assumes a grayish appearance. Each sorus appears as a slightly raised papilla distinctly cup-shaped (PLATE 18, FIG. 2; PLATE 21, FIG. 1) with a thick, dark border.

The sclerotium is of almost flinty consistency, such that it is almost impossible to cut it. By boiling in dilute potash it is however softened to a cheesy consistency and may be readily cut by razor or imbedded in paraffine and cut on the microtome. Boiling in dilute lactic acid is also helpful. In microscopic view of the sclerotium in section the greater part of the interior of the mass is seen to be composed of intricately interwoven, coarse, irregular, hyaline mycelium. The periphery only is differentiated into a cortical or rind region. This is quite dark brown, about $18\ \mu$ thick and is subtended by an inner cortex, less dark, about $50\ \mu$ thick which merges indefinitely into the central plexus. The second or inner cortex is composed of fine hyphae, about $2\ \mu$ thick, *i.e.*, about half as thick as the coarse hyaline mycelium composing the body of the structure.

The sori, I use this term merely with the significance of spore beds, are of genuine cup-shape, resembling in general aspect the cup of *Aecidium*. They are sunken into the periphery of the stroma, and their sides, peridia, project very slightly above the level of the surrounding stroma. On sides and bottom the sori are bordered by a dark layer, of much the same texture and color as the rind of the stroma, this layer merging somewhat indefinitely into the body of the stroma.

While the border of the sorus is composed of crooked interwoven hyphae the central region of the cup is filled with the slender, long, parallel conidiophores. They are hyaline, or very faintly straw colored, and are divided by many septa into cells which are quite uniformly $5-6\ \mu$ long. These are not conidiiferous in the basal portion, but are so for a considerable distance at the distal end.

Though very small and thus very difficult of observation it appears that the spores are borne laterally on the conidiophores on short sterigmata, probably more than one (2-3 or 4) arising

at one node of the conidiophores. The conidia are produced in great numbers and rest in heaps on each sorus.

The relationship of this fungus is problematic. Were it to be considered on general principles it appears to me that it must be assigned to the Fungi Imperfecti. There, however, it shows no close relationship with either of the three large orders. It certainly is not pycnidial. I do not think the sorus can properly be regarded as an acervulus though there is some superficial resemblance to one. There remains only the Moniliales where it would have to fall either with the Moniliaceae or the Stilbaceae with neither of which does it agree well. There is no genus in any of the groups mentioned above that presents characters showing even remote relationship to this genus. *Coniosporium*, which is sometimes mentioned as resembling *Graphiola* in its mode of bearing spores, certainly shows no similarity with our fungus.

There is one genus, however, sometimes placed in the Fungi Imperfecti, viz., *Graphiola*, with which it does show certain important characters of agreement though there are many important differences. The points of resemblance are as follows: the manner in which the conidia are borne, pleurogenous, on the conidiophores; the close parallel arrangement of the conidiophores, fertile only on the distal portion; the cup-like receptacle in which the conidiophores are borne; the dark border of the peridium bounding the sorus; parasitic on a monocotyledonous plant.

The points of difference from *Graphiola* are as follows: the well-developed sclerotoid stroma with the sori sunken in its periphery; the lack of a parallel arrangement of the mycelium of the peridium; the light color of the peridium; the absence of long sterile conidiophores among the fertile (not always present in *Graphiola*); the dark color of the conidia.

The differences from *Graphiola* are certainly strongly marked; nevertheless, in the absence of any evident relationship with any other group of fungi, it appears to me that the agreements in character indicated above warrant the placing of this genus in the Graphiolaceae.

The relationship of *Graphiola* has long been in doubt, it having

been variously assigned to the Uredinales, the Ustilaginales, the Pyrenomycetes and the Fungi Imperfecti. An extensive investigation by E. Fisher¹ working under DeBary in 1883 led him to the conclusion that *Graphiola*, while not to be placed in the Ustilaginales, showed nearest relation to this order. *Stylina*, another genus in the Graphiolaceae, as characterized by Sydow,² has several sori in a stroma and the sterile hyphal bundles are lacking, thus rendering this fungus somewhat nearer to ours in character than is *Graphiola*. *Farysia*, which shows superficial resemblances to *Graphiola* in the possession of sterile hyphal bundles³ and in some other detail of structure, appears to present a very different manner of spore formation from that of the Graphiolaceae. Sydow and Butler⁴ describing *Graphiola Borassi* refer to the sterile filaments. They cite the spores as being produced on the upper segments of the fertile hyphae as 3 to 8 linear protrusions, usually four. The sterile bundles between the fertile are clearly shown in their figures. It is different from *G. Phoenicis* in that it long remains covered. The mode of spore production in this species appears to differ somewhat from our form in that the separate cells of the conidiophores fall apart.

The form sometimes called *Graphiola macrospora* Penz. & Sacc., also *Melanconium profundus* Penz. & Sacc.,⁵ should properly be placed in the genus *Endocalyx* as *E. melanoxanthus* Berk. & Br. Its spores are black and its essential morphology is so different from *Graphiola* that it need not be further considered.

In the new system of von Höhnelt⁶ the genus *Graphiola* is placed in the Stromataceen-Angiostromaceae, Pachystromaceen-Sphaeriales-Jacentae-Coriaceae. Independent of our conclusion

¹ Fisher, Ed. Beitrag zur Kenntniss der Gattung *Graphiola*. Bot. Zeit. 41: 745. 1883.

² In Fischer, Ed. Zur Kenntnis von *Graphiola* und *Farysia*. Ann. Myc. 18: 188. 1920.

³ Raciborski, M. Parasitische und epiphytische Pilze Javas. Bull. Acad. Sci. Cracovie 1909: 346-394. 1909.

⁴ Sydow, H. & P., & Butler, E. J. Fungi Indiae orientalis. Ann. Myc. 5: 489. 1907.

⁵ Petch, T. The genus *Endocalyx*, Berkeley and Broome. Ann. Bot. 22: 389. 1908.

⁶ Höhnelt, F. von. System der Fungi imperfecti Fuckel. Mykol. Unters. Berichte 1: 301. 1923.

as to the relationship of our fungus to *Graphiola* it appears to fall in the von Höhnelt system in a position near to *Graphiola*.

If it be tentatively admitted that this fungus belongs to the Graphiolaceae its differences from the previously known forms in that group are so great that little or no suggestion of phylogeny can be apparent until other intermediate forms are found.

Clypeodiplodina Stevens, gen. nov.

Pycnidia immersed, early thickened to a clypeus above, astomate, opening by rupture and fragmentation of the upper wall. Conidia oblong, hyaline, 1-septate.

Clypeodiplodina Baccharidis Stevens, sp. nov.

Pycnidia roughly circular, 150–520 μ in diameter, about 150 μ deep, closed when young, later opening by rupture. Mouth of open pycnidium 90–390 μ in diameter, internal wall about 10–18 μ thick, hyaline, external edge up to 55 μ thick and 90 μ long, densely black. Hyaline wall sporiferous throughout, black wall sterile. Conidiophores short, 3–4 μ , from a hyaline pseudoparenchyma. Conidia hyaline, irregular, 25–40 \times 7 μ , 1-septate when mature.

On *Baccharis floribunda* (parasitic on the living leaves).

Ecuador, Guapulo, Nov. 12, 1924. No. 267.

The black pycnidia are usually clustered in irregular groups that may cover a whole leaf or half of it or any portion of it (PLATE 20). The groups are very irregular in outline and arrangement, sometimes occupying all of one side of a leaf, or all of a base, or all of a tip, the other portions being quite free of fungus. The disease appears to be progressive in that the younger pycnidia are at the edges of the pycnidial groups.

In very old groups the pycnidia appear to coalesce so that their individuality is lost and merely a thick black crust remains. In this stage the pycnidia cease to function, no longer bearing conidia, and the black crust appears to be composed of numerous globose aggregations, densely black on the outside and hyaline within, appearing to be sclerotia. It is possible that these later develop asci, but diligent search has failed to reveal such.

The pycnidia develop subepidermally in the mesophyll, but as they grow, compress the overlying cells and eventually replace them

by the clypeus-like thickening of the distal part of the pycnidial wall. Frequently the clypeus attains to $80\ \mu$ in thickness before rupturing. The conidiophores are short, mere projections from the hymenial cells. Black setae are quite common though not constant on the pycnidia. In some instances they appear to arise from a black superficial mycelium. It is possible, though not probable, that they belong to this fungus.

The relationship of this fungus is somewhat questionable. Observed in its younger stages of development it is a nearly globose, pycnidium-like structure, with a well-defined wall surrounding it, while the upper part of the wall immediately under the host epidermis is darkened and thickened. At this stage it appears clearly to belong to the Sphaeropsidales, though the entire absence of an ostiole is somewhat unusual. In mature form the spore-bearing region gives no hint of its earlier covered condition, but is wide open, cup-shaped, and would appear to belong possibly to the acervuli fungi, though sections show that its admission to that group is precluded by the walls of the sorus. One turns then to the Leptostromataceae or Excipulaceae as possibilities. Both of these groups are poorly characterized and contain at present many fungi that should properly be placed elsewhere. The genera of the Hyalodidymae, in those two families, which are nearest to our fungus are *Leptothyrella* and *Discella* respectively.

Our fungus cannot be *Leptothyrella* which is radiate nor does it appear to be nearly related to *Discella*, most species of which are saprophytes on wood and of structure quite different from ours. Both of these genera also present the flat base which probably should be regarded as truly characteristic of these two orders. In the Sphaerioideae-hyalodidymae our fungus would fall near *Diplodina*, but is widely separated from it by the absence of an ostiole; cup-like character of the mature sorus; and what is perhaps most significant, by the clypeus-like structure of the upper wall of the pycnidium and later the thick, black, peridium-like lip which surrounds the sporogenous region.

The bottom of the pycnidium both in immature and mature forms is never flattened, but is always concave, which character alone seems to me sufficient to prevent placing it in the Lepto-

stromataceae or Excipulaceae and results in placing it in the Sphaerioidaceae. Following the system of von Höhnelt⁷ our fungus would go to Pycnidiaceen, Pycnidieen, Sphaerioidae-astomae, which in the Hyalodidymae has only two genera, *Puccinospora* and *Scaphidium*, both quite distinct from ours. In view of these facts it is proposed as a new genus of the Sphaerioidae-hyalodidymae, the most distinctive character being the clypeus on the young pycnidia, which develops to form the large thick lip to the open disc at maturity.

Chaetothyriopsis Stevens & Dorman, gen. nov.

Thallus radiate, superficial, no free mycelium; perithecia setose, single, ostiolate, round, brown; spores 1-septate, hyaline; asci clavate, paraphysate, 8-spored.

Similar to *Microthyrium* but setose.

Chaetothyriopsis panamensis Stevens & Dorman, sp. nov.

Perithecium 40–70 μ in diameter, radiate, ostiolate, setae usually 3–4, simple, septate and arising mostly from the dark border of the ostiole, 36–70 μ long, 4 μ thick at base, tapering gradually from base to tip, dark at base, pale at tip; asci 21–22 \times 7 μ , clavate, 8-spored; spores hyaline, 1-septate, elliptical, inordinate, 7 \times 2 μ .

On the upper surface of the leaves of *Oncoba laurina*. Panama, Darien, Sept. 10, 1924. No. 411.

This fungus is quite invisible except with the aid of a compound microscope, nor are there any appearances of parasitism. It was discovered merely by accident when searching the leaf for other fungi. The perithecium bears resemblance to that of *Actinopeltis* but our fungus is not parasitic on another fungus, nor do its spores agree at all with those of *Actinopeltis*. The ostiole is very definitely bordered by about three rows of very dark cells.

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⁷ Höhnelt, F. von. System der Fungi imperfecti Fuckel. Mycol. Unters. Berichte 1: 301. 1923.

EXPLANATION OF PLATES

PLATE 18

Fig. 1. *Shropshiria*: somewhat diagrammatic view, showing location of the sori around the periphery of the sclerotium.

Fig. 2. *Shropshiria*: section of a sporogenous cup, showing wall, base, and the parallel conidiophores in the central region.

Fig. 3. *Clypeodiplodina*: drawing, diagrammatic, showing various shapes of pycnidia, and ostioles of various ages.

Fig. 4. *Clypeodiplodina*: an unopened pycnidium showing the distinct surrounding wall, especially thickened at the top.

Fig. 5. *Clypeodiplodina*: section of an old pycnidium showing its cup-like shape and the large development of the black pseudoparenchymatous border.

Fig. 6. *Clypeodiplodina*: detail of pycnidial wall, conidiophores and conidia.

Fig. 7. *Clypeodiplodina*: conidia showing shape and septation.

Fig. 8. *Chaetothyriopsis*: three perithecia showing the radiate structure and the setae.

Fig. 9. *Chaetothyriopsis*: an ascus and spores.

PLATE 19

Shropshiria: photograph showing four stromata about natural size.

PLATE 20

Clypeodiplodina: photograph showing general aspect of the fungus on the leaves.

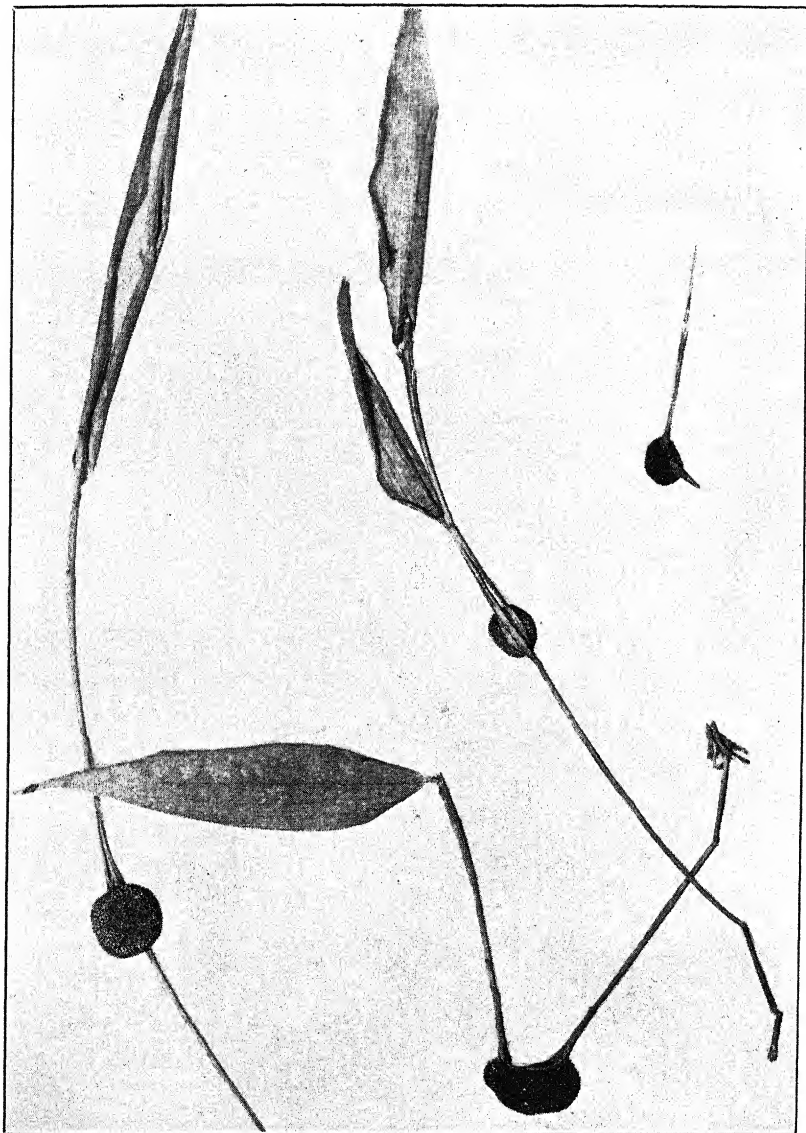
PLATE 21

Fig. 1. *Shropshiria*: photograph of a single stroma enlarged to show the sori.

Fig. 2. *Clypeodiplodina*: photograph of a leaf cleared by boiling in dilute potash, showing the individual pycnidia.

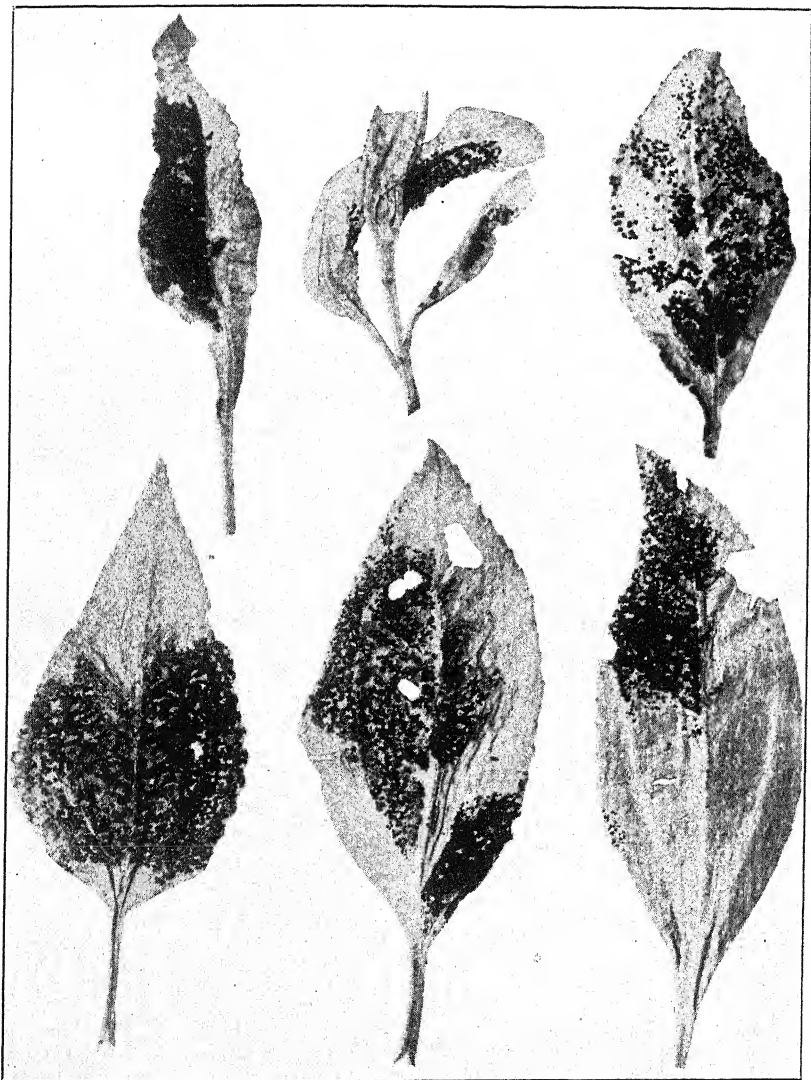
Fig. 3. *Clypeodiplodina*: photograph showing older pycnidia of more complex structure than those of Fig. 2.

Fig. 4. *Clypeodiplodina*: photomicrograph of a pycnidium in median section.

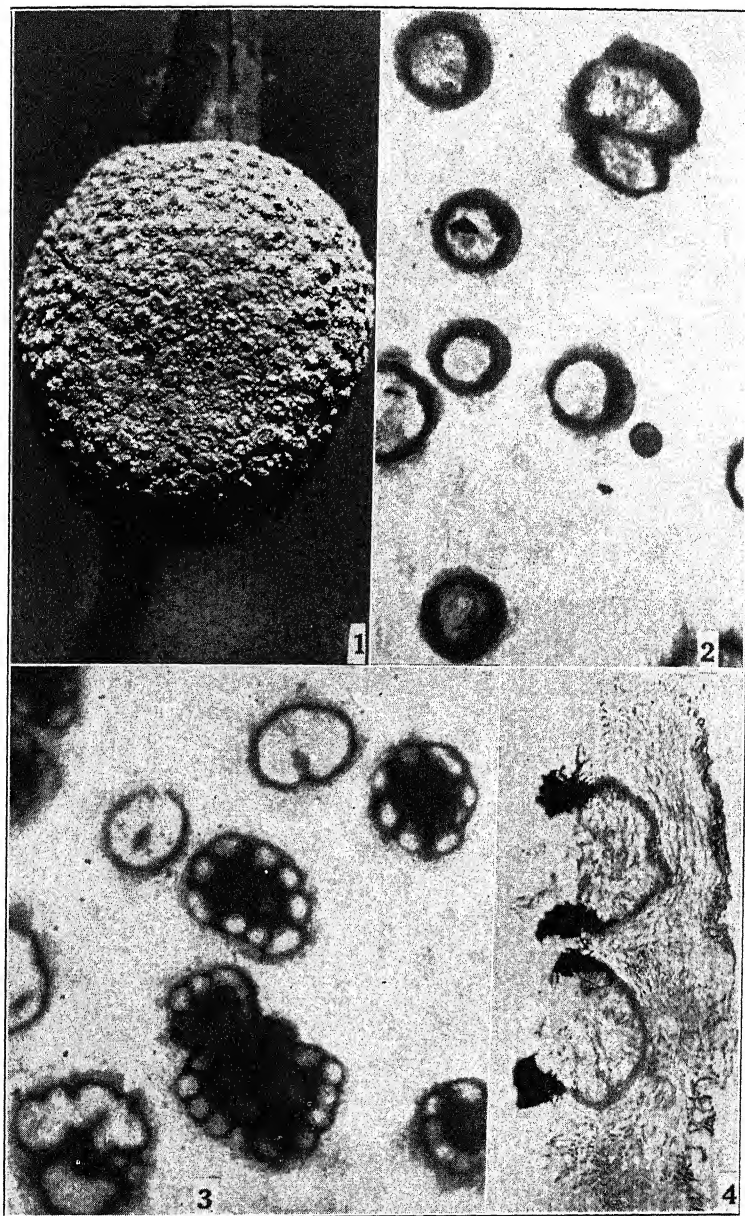


SHROPSHIRIA





CLYPEODIPLODINA



SHROPSHIRIA AND CLYPEODIPLODINA

BASIDIA AND SPORES OF THE NIDULARIACEAE

G. W. MARTIN

(WITH PLATES 22 AND 23)

Ever since the classic work of the Tulasnes (11), the position of the Nidulariaceae as Basidiomycetes has been definitely established. Later authors have contributed much to our knowledge of the taxonomy and morphology of the group, but surprisingly little has been added to what the Tulasnes published concerning the basidia. This is partly to be explained by the fact that the time during which spores may be found on the basidia is comparatively short, and the spores are shed and the basidia collapse long before the peridioles are exposed. The Tulasnes note that after their discharge the basidiospores of *Cyathus striatus* develop a thick spore wall, and Sachs (8) observed a similar change in the spores of *Crucibulum vulgare*, but these observations seem not to have been extended to other species. Besides the authors cited, R. E. Fries (4, 5) and Walker (12) have published excellent figures of the basidia of the Nidulariaceae, but these were incidental to morphological and cytological studies, and were made from fixed and stained sections. It seemed desirable, therefore, to make a comparative study of the basidia of as many species as possible. The present paper is based on the examination of three species of *Cyathus*, one of *Crucibulum*, and one of *Nidularia*, of all of which living as well as dried material was available. The dried specimens were soaked in water for at least an hour, then very thin freehand sections were cut and mounted in dilute potassium hydroxide solution, sometimes stained lightly with eosin. Living material was sectioned similarly and either examined untreated or killed in Gram's Iodine solution and stained with eosin. In all five species studied, it was found that the basidia appear when the basidiocarp is less than half its full size. They are at first

clavate or ovate and usually arranged in an hymenial region, lining the inner side of the peridiole wall. They bear their spores and shed them through a brief period, and then completely disappear, leaving the spores immersed in a gelatinous matrix in the center of the peridiole. The spores are not discharged, but are forced from the basidia by the swelling and gelatinization of the tissues lining the peridiole wall, and either preceding or immediately following such separation, the basidia themselves collapse and become gelatinized. After leaving the basidia, the spores undergo a further development. This may involve nothing more than a thickening of the outer spore wall, or it may result in a very great enlargement of the spore itself, continuing after the exposure of the peridiole. It is worthy of note that the spores of all three species of *Cyathus* examined are sessile, while those of *Nidularia* and *Crucibulum* are borne on sterigmata. This would tend to confirm the opinion, previously advanced on other grounds, that *Nidularia* and *Crucibulum* are more closely related to each other than to *Cyathus* and that they are the more primitive genera.

More detailed observations are given under the notes on the individual species.

CRUCIBULUM VULGARE Tul.

The basidia are borne in clusters, each with a clamp connection at its base. As the basidium develops, the outer wall, except at the extreme tip, becomes highly gelatinized (PLATE 23, FIGS. 47, 49), and the protoplasm is restricted to a narrow lumen, giving it more of a clavate or stalked appearance than its actual dimensions justify. Four sterigmata are formed and a swelling at the tip of each grows into a spore. In some cases, the gelatinized basidia shrivel without giving rise to spores (PLATE 23, FIG. 48). When the spores have reached their full size, the gelatinous outer wall of the basidium has, as a rule, become indistinguishable. All but one of the basidia observed were four-spored (PLATE 23, FIGS. 50-55). The exception (PLATE 23, FIG. 56) bore two spores, one of which was much larger than the other, and was clearly abnormal. The sterigmata are often of unequal lengths. While the spore is attached to the sterigma,

there is no trace of a hilum. Immediately after its separation there is a slight projection at one end which later disappears. This evidently represents nothing more than the place of attachment. The spores are not discharged, but are forced from the sterigmata and toward the center of the peridiole by the gelatinization of the underlying tissues.

The Tulasnes illustrate a number of basidia of this species, several of them two- or three-spored and some appearing abnormal.

NIDULARIA PULVINATA (Schw.) Fries

This is the species called *Nidularia pisiformis* by Lloyd (6) and *Granularia pulvinata* by Miss White (13). The basidia are usually clustered as in *Crucibulum* (PLATE 22, FIG. 3), but they are also borne singly. The gelatinization is apparent at an early stage (PLATE 22, FIGS. 1, 2) and is even more extreme than in the preceding form. While most of the basidia are three- or four-spored (PLATE 22, FIGS. 3, 7-10), a number of two-spored basidia (PLATE 22, FIGS. 5, 6) and a few bearing but one spore (PLATE 22, FIG. 4) were observed. Many of the spores, when freed from the basidia, carry with them the major portion of the sterigma upon which they were borne (PLATE 22, FIG. 11). In *Nidularia pulvinata* the hymenium is more definite than in any of the other species examined.

The Tulasnes (11) illustrate basidia of *Nidularia australis* and *N. Duriaeana*, showing them as two- and three-spored and with short sterigmata, and Fries (4, 5) shows basidia of *N. pisiformis* with four, three and two spores on rather long sterigmata.

CYATHUS STRIATUS Pers. var. SCHWEINITZII Tul.

The basidia are clavate, with very long stalks so that the basal septum is immersed in a gelatinous mass and difficult to see. I was unable to determine whether or not a clamp connection is present, as in the other forms studied. The basidia are regularly four-spored (PLATE 22, FIGS. 18-20), the spores sessile, rather bluntly elliptical, and at the time of leaving the basidium with a very thin wall (PLATE 22, FIG. 21). Later they develop a thick wall (PLATE 22, FIG. 22) and sometimes a faint, but distinct yellowish tint. This is somewhat accentuated by adding

KOH to the mount. There is usually a rather indefinite, hyaline gelatinous sheath around each spore, difficult to show in a drawing. There is usually evidence of increase in size after separation from the basidia. Spores from mature basidiocarps, while differing somewhat in size and shape, are much less variable than are those of *C. stercoreus*.

CYATHUS OLLA Pers.

The basidia are narrowly clavate or subcylindrical, long stemmed, and, in some cases at least, with a clamp connection at the basal septum. They bear two, three, or four sessile and broadly oval spores (PLATE 22, FIGS. 12-15). Immediately after separation from the basidia, the point of attachment is indicated by a small apiculus, which soon disappears. Many basidia collapse with the spores still attached to them (PLATE 22, FIG. 15). The spores are later separated by the usual process and the basidia eventually disappear. There is no evidence that the spores increase materially in size after leaving the basidia, but the wall may become somewhat thicker.

CYATHUS STERCOREUS (Schw.) De-Toni


The basidia are borne in clusters as in *Crucibulum* and *Nidularia*. They are broadly clavate, the upper part often being nearly globose, with a very short stalk and a prominent clamp connection at the base. The basidia are mostly four-spored. None were seen bearing less than four spores, and many with more, up to eight (PLATE 22, FIGS. 23-28). Abnormal basidia, forked or branching (PLATE 22, FIG. 24), are not uncommon, but none were seen bearing spores. Detachment of the spores is as usual in the group (PLATE 22, FIGS. 29-32). At the time of detachment they are broadly oval, and thin-walled, with a marked apiculus indicating the point of detachment. They are fairly uniform in size at this time, although even on the same basidium there may be considerable variation in this respect. They are commonly 8-10 μ in length and somewhat less in width at the time the basidia collapse and they are forced into the gelatinous interior of the peridiole. Here each spore is surrounded by a group of specialized hyphae. These hyphae

apparently arise from the inner surface of the peridiole between the basidia, although their origin is not easy to trace since all but the tips soon become empty of protoplasm. The tips are filled with dense cytoplasm and are often richly branched. They are closely appressed to the surface of the spore and obviously serve as nurse hyphae (PLATE 23, FIGS. 39-46). Under these circumstances, the spores undergo a remarkable development, increasing greatly in size, forming a thick outer wall and becoming subglobose or by pressure irregular in shape. In one instance, the outermost peridiole was removed from a young basidiocarp the epiphragm of which was just splitting. The spores were subglobose, thin-walled and with a marked apiculus, and were from 11 to 14 μ broad (PLATE 23, FIG. 37). They were surrounded by nurse hyphae, not shown in the illustration. The basidiocarp, attached to its substratum, was placed in a moist chamber, and ten days later the second peridiole was removed and the spores examined. They had enlarged to nearly three times their former diameter, all trace of the apiculus had disappeared, and the wall had become thickened (PLATE 23, FIG. 38). The nurse cells had virtually disappeared. The increase in bulk represented approximately 2600 per cent.

The very great variability in the size of the spores of this species has often been noted. Variability is illustrated by the outlines of groups of spores from four different basidiocarps collected at different times and places (PLATE 23, FIGS. 33-36). It seems obvious that the limit of size which the spores might attain in any given case would be greatly influenced by environmental conditions, particularly the amount of moisture in the substratum and in the air, after the spores are separated from the basidia. The only previous instances on record among the Basidiomycetes in which spores increase in size after separation from the basidia seem to be in *Scleroderma* and related genera. This phenomenon was first reported by the Tulasnes (10). They describe the spores as separating from the basidia while the wall is still smooth, and becoming surrounded by a mass of adventitious hyphae, under the influence of which they increase in size and develop the familiar rough walls of the genus. These results were confirmed by Bonorden (2) but denied by Sorokine

(9). Rabinowitsch (7) confirmed the findings of the Tulasnes and Bonorden in general, but describes the hyphae surrounding the spores as nearly empty and often collapsed, and does not believe that they play any significant part in the increase in spore size, accepting instead Wiesner's theory that the spore wall contains living protoplasm and grows by a process of intussusception. Beck (1) found a situation in *Phlyctospora* similar to that reported for *Scleroderma*, but in this case the enveloping hyphae remain attached to the spore, forming a surrounding hull at maturity. In all of these instances, the nature of the hyphae described seems to be similar to that of those here called the nurse hyphae of *Cyathus stercoreus*, but in none of them do spores increase so greatly in size after separation from the basidia.

SPORE DISSEMINATION IN CRUCIBULUM



No account, based on observation, has ever been given of the dissemination of spores by the bird's-nest fungi. Brefeld (3), upon theoretical considerations, decided that the spores of *Crucibulum vulgare* must be disseminated by animals eating the peridioles and voiding them, or the spores, in their feces. This view is adopted by deBary. Early in November, 1926, I was collecting Gasteromycetes in a sandy field near Iowa City. This had been planted to corn, but had not been ploughed for several years and was reverting to prairie. Half buried in the ground were the bases of the old cornstalks, nearly every one of which supported a number of basidiocarps of *Crucibulum vulgare*. Above and around every cluster of basidiocarps, on twigs, dead leaves, and similar fragments, were numerous peridioles, obviously forced out of the cups by rain drops, and glued firmly to whatever they had hit. Debris of this sort, readily transported by wind and water, and often deposited in heaps of similar material, would afford highly efficient dissemination of the fungus. Some of the fruiting bodies were brought into the laboratory and soaked for a while. When removed from the water, the peridioles could easily be spattered out of the cups by dropping water into them from a pipette a couple of feet above them. In *Cyathus stercoreus*, as in *Crucibulum*, the funiculus tends to

disappear as the peridioles age, and in this species, as in *Nidularia*, it is possible that rain may play the same rôle. In *Cyathus striatus*, on the other hand, where the funiculus is persistent and the peridioles are well down in the narrow part of the cup, this method of dissemination might be unavailable.

SUMMARY

The basidia and spores of five species belonging to the Nidulariaceae, including three species of *Cyathus*, one of *Nidularia* and one of *Crucibulum*, have been studied. The spores of *Cyathus* are sessile; those of *Nidularia* and *Crucibulum* are borne on well-developed sterigmata. The spores of all species are separated from the basidia by the collapse and gelatinization of the latter accompanied by the gelatinization of the tissues lining the walls of the peridiole. After separation, the spores remain immersed in a gelatinous matrix in the interior of the peridiole, where they undergo further development, which may consist in nothing more than a thickening of the spore wall, or may involve a very considerable enlargement of the spore itself, amounting in the case of *Cyathus stercoreus* to 2600 per cent.

A method of dissemination of the peridioles of *Crucibulum* is described.

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EXPLANATION OF PLATES

All drawings made with camera lucida. Figures 1-11 with Zeiss objective X and ocular K 3, at a magnification of 1530. Figures 12-57 with Zeiss objective D and ocular 4 at a magnification of 720. All reduced approximately one third in reproduction.

EXPLANATION OF PLATES

PLATE 22

NIDULARIA PULVINATA

1. Young basidium; 2. Young basidium with sterigmata developed; 3. Cluster of basidia; 4-10. Basidia with one, two, three, and four spores; 11. Two spores immediately after separation from basidia; sterigmata still attached.

CYATHUS OLLA

12-14. Mature basidia with two, three, and four spores; 15. Basidium collapsing with spores still attached; 16. Spores immediately after separation from basidia, showing conspicuous apiculus; 17. Older spores; apiculus nearly or quite gone.

CYATHUS STRIATUS

18-20. Mature basidia, each bearing four spores; 21. Spores immediately after separation from basidia; 22. Mature spores.

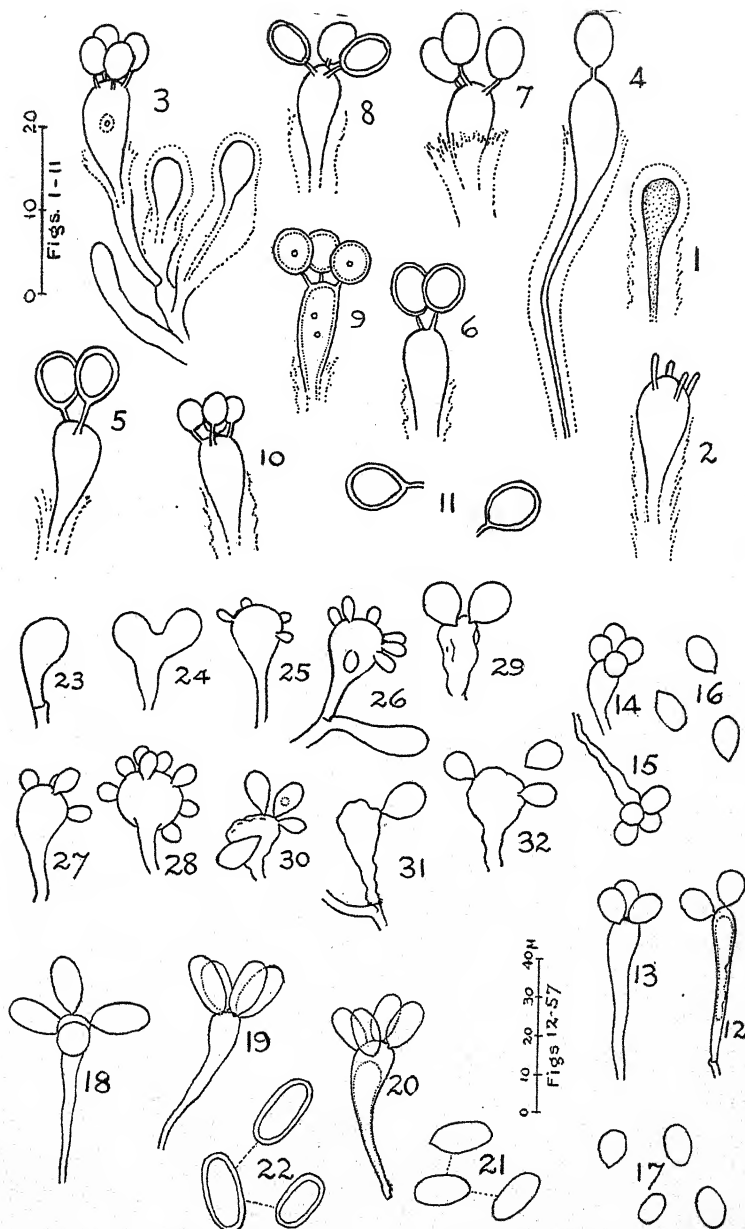
CYATHUS STERCOREUS

23. Young basidium of usual form; 24. Double basidium; 25-28. Basidia with from four to eight developing spores; 29-31. Basidia collapsing, spores still attached; 32. Collapsing basidium; two spores still attached, one just separated.

PLATE 23

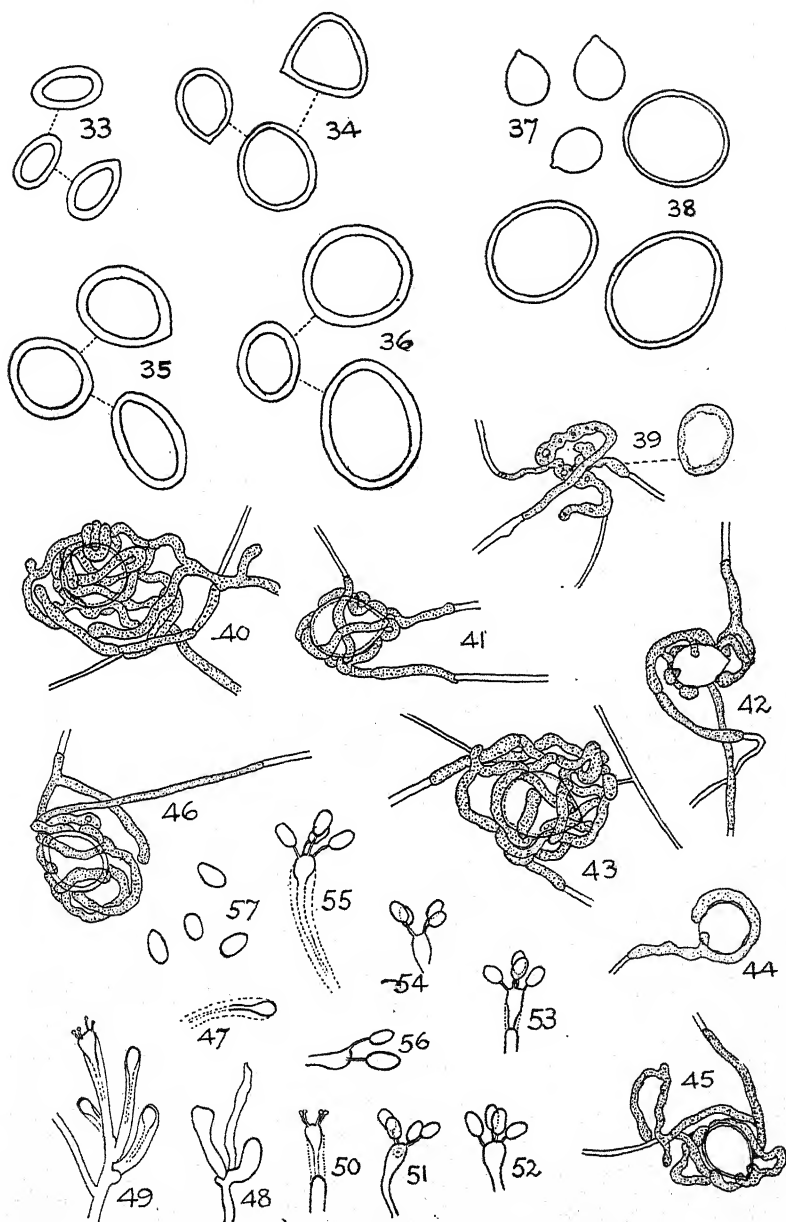
CYATHUS STERCOREUS

33-36. Four groups of three spores each from as many mature peridioles, each representing a different collection; 37. Three spores from the outermost peridiole of a newly opened basidiocarp; 38. Three spores from the second peridiole of the same basidiocarp, after ten days in a moist chamber; 39. Nurse hyphae and spore which they had surrounded, separated from them



BASIDIA AND SPORES OF THE NIDULARIACEAE





BASIDIA AND SPORES OF THE NIDULARIACEAE



by pressure on cover slip; 40-46. Spores surrounded by nurse hyphae, the latter somewhat loosened by pressure of cover slip.

CRUCIBULUM VULGARE

47. Young basidium; 48. Group of three young basidia, the middle one of which has become gelatinized and abortive; 49. Cluster of young basidia; 50. Young basidium with spores forming; 51-55. Mature or nearly mature basidia with spores; 56. Abnormal two-spored basidium; one spore unusually large; 57. Mature spores.

STUDIES OF THE FUNGOUS FLORA OF VIRGIN SOILS¹

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(WITH PLATES 24-26)

PART I

INTRODUCTION

In reviewing the literature on soil fungi and soil bacteria certain tendencies in research in this field are quite noticeable. The greater amount of work has been done with cultivated soils, in the interests of agriculture, rather than with virgin soils; more attention has been given to the physiological reactions of the fungi than to their taxonomy; more definite information seems to have been gained regarding soil bacteria than fungi. Not much has been done in determining the depth at which these fungi occur nor has much been written concerning the relative frequency with which these soil molds occur, and in only a few instances have virgin soils been studied.

Van Iterson (14), in 1904, made a study of what he presumed to be soil fungi, as he obtained them from the air over cultivated fields. In 1907 Hagem began the determination of the Mucors in soil, and in 1910 he (5) reported his findings of various fungi in the soils of Norway. In 1912 Dale (3) made an investigation of the fungi in agricultural soils fertilized with ammonium sulphate with and without lime. In 1914 she (4) made a study of the fungous flora of different kinds of soil including chalky, uncultivated mountain peat, and the "black earth" of reclaimed fenland. Dale's works were largely taxonomic. Jensen (7), in 1912, published his work on the studies of the fungi found in

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cultivated fields where crop rotation had been practiced; his work also was largely taxonomic. Waksman (15), in 1916, gave a list of 106 species of fungi he had found in garden, orchard, meadow, and forest soils. , Abbott (1), in 1926, gave a list of thirty-six species of soil fungi he found in a study of the effects of fertilization on the fungi present in cultivated soils.

The list of references here given is not intended to be complete but is a representative list to show the nature of the work that has been done in this field of study. The work reported in this paper was undertaken in an attempt to obtain some idea of the depth and frequency of the occurrence of these fungi, and also to add to what has already been done in studying the forms inhabiting virgin soils.

EXPERIMENTAL WORK

For isolating the fungi two different kinds of media were used, Cook's No. 2 and a beerwort substitute.² The beerwort substitute was used in routine work for carrying the stock cultures and growing the fungi for microscopic study.

The soils from which the organisms were isolated were open pasture land that had never been tilled, and timber land, all Clinton silt loam, near Iowa City, Iowa. The isolations were made in late September and early October. Due to a prolonged rainy season at that time the soils were at their saturation points. Samples of soil were taken twice from each kind of land at depths of one inch, three, six, and twelve inches, and once from the surface of the woodland. The samples were collected in small bottles that had been sterilized in the autoclave, and were plated out within eighteen hours after collecting. Dilutions were prepared by weighing out one gram of the wet soil and suspending it in ninety-nine cubic centimeters of sterile tap water; one loopful of this suspension was transferred to five cubic centimeters of sterile tap water, and also to a tube of each kind of medium; the medium was poured into sterile plates, and similarly a loopful from the five-cubic-centimeter

² Cook's No. 2 medium was prepared according to the formula given by Brown and Halvorsen (2), and the beerwort substitute was prepared by diluting a bottle of "near beer" (about 350 c.c.) to one liter with tap water, dissolving 15 gms. of agar-agar, filtering through cotton flannel, and sterilizing under pressure.

TABLE I

FREQUENCY AND DEPTH OF SPECIES FOUND IN OPEN PASTURE LAND

Organism	Depth				Total	Organism	Depth				Total
	1 inch	3 inches	6 inches	12 inches			1 inch	3 inches	6 inches	12 inches	
<i>Absidia subpoculata</i>		1		1	2	<i>Penicillium chrysogenum</i>	1			1	2
<i>Zygorrhynchus Moelleri</i> ...	1		1		2	<i>Hormodendrum cladosporioides</i>	27	3	2	1	33
<i>Aspergillus fumigatus</i>	95	1			96	<i>Hormodendrum olivaceum</i>	1				1
<i>Aspergillus versicolor</i>	1				1	<i>Acrostalagmus albus</i>	1		1		2
<i>Aspergillus terreus</i>	1				1	<i>Alternaria</i> No. 1.....	3	1			5
<i>Aspergillus olivaceus</i>	1				1	<i>Alternaria</i> No. 2.....	1		1		2
<i>Penicillium decumbens</i>				1	1	<i>Alternaria</i> No. 3.....	1		1		2
<i>Penicillium roseum</i>	1		1		2	<i>Alternaria</i> No. 5.....	1				1
<i>Penicillium biforme</i>	1				1	<i>Fusarium</i>	1	1	1		3
<i>Penicillium atramentosum</i> ..			1		1						

TABLE II

FREQUENCY AND DEPTH OF SPECIES FOUND IN WOODLAND

Organism	Depth					Total	Organism	Depth					Total
	Surface	1 inch	3 inches	6 inches	12 inches			Surface	1 inch	3 inches	6 inches	12 inches	
<i>Mucor hiemalis</i>	3			1		4	<i>Spicaria elegans</i>		1				1
<i>Mucor Ramannianus</i> ..	1				1	2	<i>Hormodendrum cladosporioides</i>		4	30	2		36
<i>Mucor mirus</i>		1	1			2	<i>Hormodendrum nigrescens</i>	1					1
<i>Mucor echinulatus</i>	1					1	<i>Hormodendrum viride</i> ..		2	1			3
<i>Cunninghamella verticillata</i>					1	1	<i>Stackybotrys cylindrospora</i>				1		1
<i>Chaetomium bostrychodes</i>		1	2			3	<i>Trichoderma lignorum</i>		2			1	3
<i>Aspergillus nidulans</i> ..		1			1	2	<i>Gliobotrys albo-viridis</i> ..		1				1
<i>Aspergillus niger</i>	1					1	<i>Acrostalagmus albus</i>	1					1
<i>Aspergillus conicus</i>	3					3	<i>Alternaria</i> No. 4.....		1		3		4
<i>Aspergillus Sydowi</i>				1		1	<i>Coniothyrium</i>				1	1	2
<i>Penicillium atramentosum</i>		2	1			3	<i>Cephalosporium</i>	2	1	2			5
<i>Penicillium echinatum</i> ..		2				2							

suspension was inoculated into a tube of each of the different kinds of media and poured into sterile plates. The plates were incubated three days at room temperature. After the three days of incubation the different types of colonies were counted, notes made of the number and depths from which they came, and transfers made to "near beer" agar slants. These findings are recorded in tables I and II.

It would seem, from tables I and II, that Mucors are not as abundant in the open pasture land as they are in the forest areas; that *Aspergillus fumigatus* and *Hormodendrum cladosporioides* are very common inhabitants of open pasture soils, particularly near the surface, and also that species of *Alternaria* are frequent inhabitants of such soils. *Hormodendrum cladosporioides* seems also to occur frequently in timber soils. It is interesting to note that the species of *Coniothyrium*, representing a genus commonly parasitic on higher plants, was found six and twelve inches below the surface, and that the *Cunninghamella*, a new species, was also found twelve inches below the surface.

The identification of the species found made up a large part of the problem undertaken. All the supposedly pure cultures were plated out by dilution at least twice, picking each time what seemed to be pure colonies, to minimize the possibility of dealing with mixed cultures. Descriptions of the identified forms follow.

DESCRIPTIONS OF SPECIES FOUND

PHYCOMYCETES

1. *Absidia subpoculata* n. sp.

Colonies white, floccose, aerial hyphae growing to a height of 1.5 to 2 cm., somewhat spreading. Sporangiphores branched, with shorter sporangiphores borne as lateral branches, one to five, on the main sporangiphore, the branches 100 to 300 μ long by 4 μ in diameter with a septum 10 to 12 μ below the tip. The sporangium has a thick, diffuent wall often leaving a collar attached to the columella; it is globose, 22 to 24 μ in diameter, quite uniform in size, smooth, columella oval, slightly constricted at the apophysis, 4 to 7 μ by 8 to 9 μ . Spores very numerous, oval or spherical to allantoid, 2 to 2.5 by 3 to 4 μ . Chlamydospores quite numerous, spherical, 4 to 5 μ in diameter.

Hab. Found in open pasture land 12 in. below the surface.

2. *MUCOR HIEMALIS* Wehmer.

Colonies white, floccose, 0.5 to 2 cm. high. Sporangioophores hyaline, unbranched, 1.5 or more cm. long by 5 to 8 μ thick, arising singly from the substratum. Sporangia dark, spherical to subglobose, smooth, deliquescent when old, 65 to 75 μ in diameter. Columella 35 to 40 μ in diameter, oval, somewhat flattened at the base. Spores round, hyaline (smoky in mass), 8 to 11 μ in diameter. Chlamydospores not conspicuous, somewhat irregular in form and size.

Hab. Found in timber land from the surface to 6 in. below the surface.

3. *MUCOR RAMANNIANUS* Moeller.

Colonies somewhat spreading, zonate, often papillate near the center, velvety, rusty red in color. Sporangioophores hyaline, unbranched, 50 to 100 μ long by 4 μ thick, arising in large numbers from the substratum. The sporangia spherical, quite uniform in size, 13 to 14 μ in diameter, deliquescent. Columella spherical, 5 to 6 μ in diameter. Chlamydospores appear as irregular oval or spherical swellings in the vegetative hyphae of the substratum.

Hab. Found in timber soil on the surface and 12 in. below the surface.

4. *Mucor mirus* n. sp.

Colonies flat, except that they are usually papillate in the center, zonate, quite spreading, velvety, ashy gray, scarcely any elevation. Sporangioophores unbranched, arising in the margin of the colony in large numbers but not numerous inside the margin, rather delicate and slender, 125 to 300 μ long and 2 to 2.5 μ thick. Sporangia smoky, spherical, 10 to 30 μ in diameter, appearing slightly rough; the sporangial wall is deliquescent, leaving no collar. Columella spherical, 5 to 12 μ in diameter. Spores small, 2.5 to 3.5 μ in diameter, often oval and slightly pointed at the ends. Chlamydospores are exceedingly numerous, and appear as large globular swellings in the subterranean hyphae, 20 to 35 μ in diameter, and appear to contain from 2 to 8 angular spore-like bodies varying from 4 to 12 μ across, rather angular in shape.

Hab. Found in timber soil 1 to 6 in. from the surface.

This form, except for its color and habit of spreading widely, closely resembles *M. Ramannianus* in its macroscopic appearance, but differs microscopically from the latter in its long slim sporangioophore, bearing the sporangioophores mostly near the

margin of the colony, very small oval spores, and the abundance and appearance of the chlamydospores.

5. *Mucor echinulatus* n. sp.

Colonies somewhat spreading, soon developing a grayish white powdery appearance; elevation of the aërial hyphae never exceeding 2 mm. in height; turf prostrate, fragile. Sporangiophores monopodially branched, 150 to 400 μ in length by 5.5 to 8 μ thick, much vacuolated. Sporangia spherical, 40 to 50 μ in diameter, minutely echinulate, the spines being about 2 μ long; the sporangial wall deliquescent, leaving no collar. Columella spherical, quite variable in size, 15 to 25 μ in diameter. Spores ellipsoidal, 3 to 3.5 μ by 4.5 to 5.5 μ , hyaline. Chlamydospores quite numerous in old cultures, cylindrical in form, quite variable in length.

Hab. Found in the surface soil of timber land.

This species somewhat resembles *M. dispersus*, but differs from that species in scanty growth, its globose columella, and its much smaller spores.

6. *ZYGORRHYNCHUS MOELLERI* Vuillemin.

Colonies spreading rapidly, white, becoming ashy with age; aërial hyphae arising 1.5 to 2 cm. Zygosporangia numerous, rough, warty, very dark when mature, 30 to 45 μ in diameter; the larger suspensor 20 to 30 μ thick at its thickest point. Sporangiophores slender, 1 or more mm. in length and 6 to 8 μ thick. Sporangia dark, rough, nearly spherical, 40 to 50 μ in diameter, usually rupturing at the apex. Columella somewhat flattened, oval, 20 to 27 μ by 25 to 35 μ . Spores ovoid to ellipsoidal, 2.5 to 3.5 μ by 4 to 7 μ .

Hab. Found in open pasture land 1 to 6 in. below the surface.

7. *Cunninghamella verticillata* n. sp.

Colonies spreading; aërial hyphae loose, elevated, 2 to 4 cm. in height, somewhat silvery, much vacuolated. Conidiophores very long, 2 cm. or more, and 12 to 14 μ in thickness. Numerous lateral branches are borne at various places along the conidiophore just below the terminal vesicle, forming a number of whorls of two to six lateral branches, each terminating in a vesicle, the conidiophore being more or less swollen at each point of attachment of the lateral branches; lateral branches not exceeding 30 μ in length, their vesicles pyriform or oval in shape, not over 16 μ in diameter. The terminal vesicle globose to oval, about

50 μ in diameter. Spores borne on the terminal vesicle ellipsoidal, pointed at the attached end, 10 μ by 13 to 15 μ ; spores borne on the lateral vesicles oval, bluntly pointed at the attached end, 8 to 12 μ by 12 to 15 μ in diameter. All spores are adorned with fine echinulations, 1.5 to 3 μ in length.

Hab. Found 12 in. below the surface in timber land.

This species differs from *C. echinulata* in size of spores, in leaving scarcely any points on the vesicles where the spores were attached, and in the appearance of the turf.

ASCOMYCETES

8. CHAETOMIUM BOSTRYCHODES Zopf.

Colony formed of sterile creeping hyphae with scarcely any elevation, at first white, later becoming brown. Perithecia quite evenly scattered over the surface of the substratum, dark olive green, 150 to 250 μ in diameter, adorned with many unbranched appendages 300 to 500 μ long tapering to a point; those from the upper part of the perithecium having from 4 to 6 spiral coils, each coil 20 to 40 μ long by 24 to 28 μ wide, the lower appendages being nearly straight. The interior of the perithecium is filled with many asci; asci clavate and borne on a rather long stipe; asci 12 to 15 μ thick by 20 to 30 μ long, the stipe 15 or more μ long, total length 45 to 60 μ . Asci usually contain 8 spores in 2 ranks. Ascospores subspherical, 7 to 8 μ by 9 to 10 μ , slightly pointed at each end.

Hab. Isolated from open pasture land 1 to 3 in. below the surface.

FUNGI IMPERFECTI

9. ASPERGILLUS FUMIGATUS Fresenius.

Colonies grayish blue, moderate elevation. Mycelium hyaline, branched. Conidiophores 150 to 300 μ long by 4 to 6 μ thick; vesicle globose to flask-shaped, 15 to 20 μ in diameter; conidia green, borne in large columnar masses, smooth, round, 2.5 to 3.5 μ in diameter, attached by 1-seriate sterigmata; sterigmata 5 to 6 μ long and somewhat pointed at the tip.

Hab. Found in pasture land soil in large numbers 1 in. from the surface and rarely 6 in. below the surface.

10. ASPERGILLUS VERSICOLOR Vuillemin.

Colony velvety, greenish blue; reverse tinged with olive green. Hyphae slightly smoky. Conidiophores unbranched, hyaline, 50

to $250\ \mu$ long by 3.5 to $4\ \mu$ in diameter; vesicle pyriform, 10 to $12\ \mu$ in diameter; sterigmata 2-seriate, 10 to $12\ \mu$ long, originating mostly at the apex of the vesicle, giving somewhat the appearance of a tuft of bristles; conidia round, greenish blue, smooth, 3 to $4\ \mu$ in diameter.

Hab. Found in pasture land soil 3 in. below the surface; not numerous.

11. *ASPERGILLUS TERREUS* Thom.

Colonies at first white, later becoming ochraceous; compact or velvety; conidiophores short, 80 to $140\ \mu$ long by 3.5 to $5\ \mu$ thick; vesicle globose to flask-shaped, 12.5 to $15\ \mu$ in diameter; sterigmata 2-seriate, the primary 6 to $7\ \mu$ long, the secondary 5 to $6\ \mu$ long; conidia globose, smooth, hyaline or nearly so, 2.5 to $3\ \mu$ in diameter.

Hab. Found in open pasture land 1 in. below the surface; not numerous.

12. *ASPERGILLUS NIDULANS* Eidam.

Colonies small and velvety, blue-green. Conidiophores short, 100 to $150\ \mu$ by $4\ \mu$; vesicle ovate, 10 to $12\ \mu$ in diameter; sterigmata 2-seriate, short and thick, total length 7 to $9\ \mu$. Conidia borne in moderately long chains, green, smooth, spherical to subspherical, 3 to $3.5\ \mu$ in diameter; the conidial mass forming a column.

Hab. Found in woodland soil 1 and 12 in. from the surface; not numerous.

13. *ASPERGILLUS NIGER* Van Tieghem.

Young colonies straw colored, finally becoming black as if dusted with a black powder; somewhat spreading, elevation 1 to 2 mm. Conidiophores long and straight; vesicle globose, 34 to $38\ \mu$ in diameter, bearing a mass of conidia that is nearly spherical in outline. Sterigmata 2-seriate, the primary 6 to $12\ \mu$ long, the secondary 5 to $9.5\ \mu$ long. Conidia borne in moderately long chains, dark, rough, spherical or nearly so, 3.5 to $4.5\ \mu$ in diameter.

Hab. Isolated from the surface soil of timber land.

14. *ASPERGILLUS CONICUS* Blochwitz.

Colonies small, wart-like, grayish blue; reverse cream colored to purplish. Conidiophores 200 to $260\ \mu$ in length by $6\ \mu$ in thickness; vesicle $10\ \mu$, or less, in diameter, ovoid. Sterigmata

1-seriate, borne on the upper half of the vesicle only, and few to moderately abundant, sometimes only a single sterigmatum with a single chain of conidia. Conidia minutely spiny to verrucose, globose to subglobose, $4\ \mu$ in diameter.

Hab. Isolated from 6 in. below the surface of forest soil.

15. *ASPERGILLUS SYDOWI* Bainier & Sartory.

Colonies small, colorless when young, becoming blue-green; surface velvety, rarely if ever becoming floccose; margin very narrow and almost colorless; reverse creamy white. Conidiophores 150 to 250 μ long by 4 to 5 μ thick, often branched, bearing conidial heads with subspherical vesicles, 10 or more μ in diameter, while others bear few to a single sterigma with a single chain of conidia. Sterigmata 2-seriate except where borne singly as lateral branches, often several secondary sterigmata borne on one primary. Primary sterigmata 6 μ long; secondary sterigmata 4.5 to 5 μ long. Conidia green, smooth, globose, 4 μ in diameter.

Hab. Found in the surface soil of forest land.

16. *ASPERGILLUS (Citromyces) OLIVACEUS* Delacroix.

Colonies green, slightly conical in the fruiting area, with a tendency to become slightly floccose with age, bordered by a hyaline margin 2 to 4 mm. wide; reverse ashy pale green to pale yellow surrounded by a hyaline margin of subterranean hyphae. Conidiophores branched, with numerous lateral branches, 50 to 100 μ , or more, in length, 3.5 to 4 μ in diameter, more or less bent, terminating in a tuft of 1-seriate sterigmata; sterigmata 3 to 8 in number, flask-shaped, 11 to 15 μ long by 4 to 4.5 μ thick, with a constricted tip. Conidia globose, 4 to 4.5 μ in diameter, smooth.

This form differs from *A. Amstelodami* (Mangin) in having smooth instead of echinulate spores, and no perithecia were demonstrated.

Hab. Found 1 in. below the surface of open pasture land.

17. *PENICILLIUM DECUMBENS* Thom.

Colonies greenish blue, only slightly elevated, margin narrow, zonate; reverse greenish yellow. Conidiophores 200 or more μ in length by 3.5 μ in diameter. Conidia borne in long chains which are twisted together like the strands of a rope, ellipsoidal to oval, 2.5 to 3 μ by 5 to 6 μ , greenish blue, fairly uniform in

size and shape. Odor, none. Gelatin liquefied in 12 days, rather viscous, and colored.

Hab. Isolated from 12 in. below the surface of open pasture land.

18. *PENICILLIUM ROSEUM* Link (?).

Colonies at first white, slightly floccose, becoming pink with age; spreading, zonate; reverse white. Conidiophores straight, coarse or fine, quite variable in length and diameter, may be a very short branch of a sterile hypha or a very long coarse stalk, 50 to 300 μ , or more, in length, by 2.5 to 4.5 μ in diameter. Conidia quite variable in size, more often fusiform, 2 to 3 μ by 2.5 to 3.5 μ , hyaline. Odor, slightly moldy. Gelatin liquefied in 6 days and colored yellow.

Hab. Found 1 in. below the surface of open pasture land.

19. *PENICILLIUM BIFORME* Thom.

Young growth white, becoming grayish with age; surface closely strict, occasionally with sterile hyaline mycelium overgrowing the conidiophores; margin narrow, usually light in color, zonate; reverse creamy white. Conidiophores branched, 75 to 150 μ long by 3.5 to 4 μ in thickness. Conidia blue, ovate to spherical, 3 to 4.5 μ in diameter, borne on flask-shaped sterigmata, with 2 to 8 in a chain. Odor, strong musty. Gelatin liquefied in 12 days without coloring the medium.

Hab. Isolated from 1 in. below the surface of open pasture land.

20. *PENICILIUM ATRAMENTOSUM* Thom.

Colonies light green with a tendency to become whitish with age, compact with central elevation and tendency to zonation; margin hyaline and narrow, 0.5 to 1 mm. wide; reverse greenish yellow to orange. Conidiophores 250 to 400 μ long by 4 μ in thickness, unbranched except at the apex. Conidia somewhat angular, 2.5 to 3 μ in diameter, subspherical, green. Odor, none. Gelatin liquefied in 6 days without coloring the medium.

Hab. Found 6 in. below the surface of open pasture land.

21. *PENICILLIUM CHRYSOGENUM* Thom.

Colonies grayish blue, flat, with granular surface, spreading; reverse greenish yellow. Conidiophores septate, unbranched except at the apex, 100 to 400 μ in length by 4 to 4.5 μ in thickness. Conidia round, 3.5 to 4 μ in diameter, smooth. Odor, none. Gelatin rapidly liquefied and becoming yellowish.

Hab. Isolated from 3 in. below the surface of open pasture land.

22. *PENICILLIUM ECHINATUM* Dale.³

Colonies small to medium sized, blue gray, velvety surface, only slightly elevated, margin narrow; reverse soon becoming a deep purple or wine colored. Conidiophores branched, septate, pigmented, varying in length from short lateral branches $20\ \mu$ long to a main conidiophore 300 or more μ in length, 3.5 to $5\ \mu$ thick. Conidia verrucose, angular, orange colored, 3 to $3.5\ \mu$ in diameter, borne in chains of 20 or more. Odor, none. Gelatin rapidly liquefied without coloring the medium.

Hab. Isolated from 1 in. below the surface of timber land.

23. *SPICARIA ELEGANS* Corda.

Colonies white, floccose above and having a powdery appearance beneath. Fertile hyphae borne irregularly on the vegetative hyphae, distinctly septate, branched; the branches numerous and borne in whorls. Conidiophores short, erect, and adorned with short stout bristles. Conidia borne on flask-shaped sterigmata, in chains of 20 or more, fusiform, hyaline, 2.5 to $4\ \mu$ by 5 to $6\ \mu$.

Hab. Isolated from timber land soil 1 in. from the surface.

24. *HORMODENDRUM CLADOSPORIOIDES* Fresenius.

Colonies flat, dark olive green, spreading. Conidiophores short, septate, smoky, arising from the sterile creeping hyphae, branched, 150 to $200\ \mu$ long by $4\ \mu$ thick. Conidia dark green, 1-celled, the chains often branching, quite variable in size, oval, 2 to $3\ \mu$ by 3 to $5\ \mu$ for those borne at the tips.

Hab. Found many times from 1 to 3 in. below the surface of both open pasture and timber land, and occasionally 6 in. below the surface of woodland soils.

25. *HORMODENDRUM OLIVACEUM* Corda.

Colonies olive green, slightly elevated, not spreading much; margin narrow, 1 to 1.5 mm., hyaline; reverse dark green. Sterile hyphae soon growing beyond the conidiophores as the colony matures. Conidiophores short, 75 to $200\ \mu$ long, borne as short lateral branches of the sterile hyphae, unbranched except at the apex. Conidia ellipsoidal to short cylindric, 4 to

³ *P. echinatum* Dale was identified by Miss Margaret Church, U. S. Department of Agriculture, Bureau of Animal Industry, Washington, D. C.

5 μ by 8 to 12 μ , with intermediate cells of the chain swollen, and terminal cells often much smaller, and globose.

Hab. Isolated from pasture land 1 in. below the surface.

26. *Hormodendrum nigrescens* n. sp.

Colonies somewhat elevated, at first hyaline, becoming olive green, and finally black beneath a white surface; hyaline mycelium appearing slightly floccose; margin 2 or more mm. wide, hyaline. Sterile hyphae arising at the apex of the colony as fine bristle-like tufts above the conidiophores. Conidiophores originating in the substratum, smoky, 300 to 400 μ long by 4.5 to 5 μ in thickness, dendroidally branched, erect. Conidia green, subspherical to ellipsoidal or fusiform, though seldom pointed at the ends, 4 to 10 μ by 2.5 to 4 μ .

Hab. Found in timber land soil, on the surface and 6 in. below the surface.

This form differs from *H. olivaceum*, which it resembles, in shape and size of conidia; in the origin and length of the conidiophores; and in the coarseness and abundance of the sterile hyphae.

27. *HORMODENDRUM VIRIDE* Fresenius.

Colonies somewhat floccose above an olive green, somewhat restricted growth of creeping hyphae. Conidiophores short, dendroidally branched. Conidia yellowish green, very irregular in shape and size; oval to cylindrical, sometimes indistinctly guttulated, smooth, 4 to 12 μ by 2 to 4 μ .

Hab. Found in the surface soil of timber land.

✓ 28. *STACHYBOTRYS CYLINDROSPORA* Jensen.

Colonies spreading, somewhat zonate, becoming sooty with age. Sterile hyphae hyaline, prostrate, creeping, branched. Conidiophores unbranched, hyaline at the base, becoming fuliginous near the apex, and tapering, 65 to 85 μ in length by 3 to 3.5 μ in thickness; sterigmata 4 to 9 in number, borne at the apex of the conidiophore, 11 μ by 4 to 5 μ . Conidia black, easily detached from the sterigmata, ellipsoidal, 1-celled, 2.5 to 4 μ by 5 to 10 μ .

Hab. Isolated from soil 6 in. below the surface of timber land.

29. *TRICHODERMA LIGNORUM* Tode.

Colonies of a scanty spreading growth of hyaline mycelium, forming in 3 to 5 days green cushion-like structures of fruiting

masses. Conidiophores verticillately branched. Conidia green, spherical or nearly so, 1-celled, 2.5 to 3 μ in diameter.

Hab. Found in woodland soil from the surface to 12 in. below the surface.

30. GLIOBOTRYS ALBO-VIRIDIS von Höhnelt.

Colonies flat and spreading; the sterile hyphae very crooked, septate, 3 to 7.5 μ in thickness, profusely branched, greenish colored; aerial hyphae bearing lateral branches of fertile hyphae. The fertile hyphae branched, each branch terminating in a spherical envelope filled with globular spores. When young and immature a slimy capsule appears to surround the adjacent young envelopes of the secondary branches. Conidiophores smoky, 20 to 30 μ long by 3 μ thick, verticillately branched at the tips, usually 3 branches, the terminal branches 9 to 14 μ long by 3 μ in thickness. Conidia borne in slime, globose to ovoid, 3.5 to 4 μ in diameter, smooth, green. Many chlamydo-spores are borne in the substratum.

Hab. Isolated from the surface soil of timber land.

31. ACROSTALAGMUS ALBUS Preuss.

Colonies white, very floccose, spreading, elevated; mycelium septate. Conidiophores more or less septate near the base, rather crooked, 50 to 150 μ long by 4 μ thick, often profusely branched near the tip; branches in whorls of 2 to 4, usually 3. Sterigmata somewhat club-shaped, tapering toward the tip, 10 to 13 μ long, in whorls of 2 to 4 usually. Conidia ellipsoidal to crescentiform or allantoid, hyaline, smooth, 4 to 9 (rarely 9) μ by 2.5 to 4 μ .

Hab. Found in open pasture land 1 to 12 in. below the surface, and on the surface of timber land.

Among the several species of fungi found there were five distinct species of *Alternaria*, the identification of which was a greater problem than could be included in this work. They were all frequently found and have likely been seen by other investigators. They are reported here by number and briefly described.

32. ALTERNARIA No. 1.

Colonies somewhat spreading, with a margin 2 to 3 mm. wide, dark olive green; aerial hyphae extending up to 10 to 15 mm., floccose, smoky to nearly hyaline, dense. Subterranean

hyphae dark olive green, straight. Conidiophores numerous, short, septate, straight, often more or less constricted, dark, 4 to 5 μ in diameter. Conidia smooth, usually 3- to 8-celled, 12 to 36 μ long by 6 to 12 μ broad, moderately muriform, brown, borne in chains of 2 to 10 usually.

Hab. Isolated from open pasture land 1 to 6 in. below the surface.

33. ALTERNARIA No. 2.

Colonies a sooty green, becoming almost black; growth 3 to 5 mm. high; no margin; distinctly zonate, with a dark central area surrounded by a light zone surrounded again by a dark zone which in turn is bordered by a second light zone; aërial hyphae short, somewhat scanty, wooly and smoky; submerged mycelium blackish green, straight; conidiophores abundant, short, branched, dark, often constricted, 3.5 to 4.5 μ in diameter. Conidia very dark, borne in long chains, often as many as 30 in a chain, strongly muriform, smooth, 2 to 12 cells, 12 to 30 μ long by 6 to 16 μ thick.

Hab. Found in open pasture land from 1 to 6 in. below the surface.

34. ALTERNARIA No. 3.

Colonies spreading, zonate, with a smoky central area, surrounded by a wide light zone bordered by a very narrow dark band and this in turn surrounded by a wider greenish gray zone which blends off into a very narrow hyaline margin. Growth 5 to 8 mm. high; aërial mycelium cottony, pale greenish gray; reverse, concentric rings of light and dark olive green; submerged mycelium olive green, nearly straight. Conidiophores numerous, dark, very short, much constricted, septate. Conidia numerous, borne in long chains, olive brown, smooth, 2- to 14-celled, scantily muriform, 6 to 12 μ by 10 to 20 μ .

Hab. Found in open pasture land 1 to 6 in. below the surface.

35. ALTERNARIA No. 4.

Colonies spreading, zonate with a dark central area surrounded by a lighter area, then a grayish wooly zone blending into a hyaline margin 1 to 2 mm. wide. Aërial hyphae not very abundant, 4 to 6 mm. high, ashy gray; submerged mycelium nearly straight, dark olive green, moderately branched; conidiophores very numerous, normal or only slightly constricted, dark green, 40 to 50 μ long by 6 to 7 μ thick. Conidia very numerous,

borne in long chains, often containing many cells, rough, muriform, dark olive brown, 18 to 32 μ long by 7 to 14 μ in thickness.

Hab. Isolated from timber land soil 1 to 6 in. below the surface.

36. ALTERNARIA NO. 5.

Colonies without zonation, no pronounced spreading, no margin; aërial hyphae abundant, grayish green, wooly; submerged mycelium dark olive green, straight. Conidiophores scanty, short, many septa, constricted, 5 or more μ in thickness. Conidia not numerous, borne in short chains, rarely more than 5 or 6 in a chain, short, thick, profusely muriform, olive green.

Hab. Isolated from open pasture land 1 in. from the surface.

37. CONIOTHYRIUM (species not identified).

Pycnidia borne more or less scattered on the surface of the medium as dark brown specks; measurements from a fixed section, 100 to 160 μ . The surface of the medium covered with a thin mat of sterile creeping mycelium. Spores borne in the pycnidium in large numbers, purple, ovate, 2.5 to 3 μ by 4 to 5 μ .

Hab. Isolated from the soil of timber land 6 and 12 in. below the surface.

PART II

CELLULOSE FERMENTATION

INTRODUCTION

Of the various physiological reactions of soil fungi their action on cellulose has been studied as one of the most important. As early as 1902 Omelianski (11) demonstrated the ability of certain soil bacteria to ferment cellulose. Others soon took up the study of cellulose fermentation. In 1904 Van Iterson (14), during his work of isolating air fungi, showed that many of them could cause cellulose decay. In 1912 Kellerman and McBeth (9) published a formula for preparing cellulose agar medium on which to test cellulose digestion. Since then this medium, or a modification of it, has been generally used in cellulose fermentation studies. The medium⁴ used in this work differs from that

⁴ Note: The medium used in this work was made up as follows: one liter of distilled water, four grams of ammonium phosphate, two grams of dipotassium phosphate, and two tenths of one gram of magnesium sulphate.

reported by previous workers in that all sources of carbon are eliminated except that in the cellulose material and that in the traces of carbon dioxide in the air. With cellulose agar Kellerman (8), in 1913, showed the excretion of cytase by *Penicillium pinophilum*. In 1915 Scales (12) gave a list of thirty-one species of cellulose fermenting fungi, but these were not nearly all soil forms. Murray (10), in 1921, reported his findings on the effects of different amounts of straw, used as fertilizer, on the total and available nitrogen in such fertilized soils. In 1924 Starkey (13) gave the results of his study on the rate of decomposition of different kinds of organic material (dried blood, mold mycelium, alfalfa meal, rye straw, and dextrose) and their effects on the amount of available nitrogen. Heukelekian and Waksman (6), in 1925, used *Trichoderma Koningi* and a *Penicillium* in a study of the cycle of carbon from decaying cellulose.

EXPERIMENTAL WORK

The fungi isolated in this research were inoculated into the different cellulose media and incubated at room temperature until good growth appeared, or until the thirty-fifth day when there was no growth before that time. Growth was determined by the discoloration and disintegration of the cellulose material. Organisms that failed to grow on the cotton were not cultured on filter paper. The results are shown in table III. Positive results are shown by a (+) and negative results are shown by a (-); where no test was made the place is left blank.

From table III it would appear that the *Phycomycetes* are not active fermenters of cellulose or the medium used was not suitable for their growth. Of the *Aspergilli* and the *Penicillii* it appears that many of them are able to attack cellulose though a goodly number of them cannot. Among the active cellulose destroyers of the soil may be named species of *Hormodendrum*, *Stachybotrys*, *Gliobotrys*, *Acrostalagmus*, *Alternaria*, *Fusarium*, and *Cephalosporium*.

A small amount of the cellulose material was put in a culture tube and enough of the solution was added to cover about two thirds of the cellulose material. The tubes were then sterilized under fifteen pounds of steam pressure. The cellulose materials used were cotton batting, absorbent cotton, and ashless filter paper.

TABLE III
CELLULOSE FERMENTATION

Organism	Source	Cotton batting	Absorbent cotton	Filter paper	Organism	Source	Cotton batting	Absorbent cotton	Filter paper
<i>Absidia subpoculata</i> ..	Pasture	-	-	-	<i>Penicillium chrysogenum</i>	Pasture	+	+	-
<i>Mucor hiemalis</i>	Woods	-	-	-	<i>Penicillium echinatum</i>	Woods	+	+	+
<i>Mucor Ramanianus</i>	"	-	-	-	<i>Fusarium</i>	Pasture	+	+	+
<i>Mucor mirus</i>	"	-	-	-	<i>Spicaria elegans</i>	"	-	-	-
<i>Mucor echinulatus</i> ...	"	-	-	-	<i>Hormodendrum cladosporioides</i> ...	"	+	+	+
<i>Zygorrhynchus Moelleri</i>	Pasture	-	-	-	<i>Hormodendrum olivaceum</i>	"	+	+	+
<i>Cunninghamella verticillata</i>	Woods	-	-	-	<i>Hormodendrum nigrescens</i>	Woods	-	+	+
<i>Chaetomium bostrychodes</i>	"	-	+	+	<i>Hormodendrum viride</i>	"	-	-	-
<i>Aspergillus fumigatus</i>	Pasture	+	+	+	<i>Slachybotrys cylindrospore</i>	"	+	+	+
<i>Aspergillus Tiraboschii</i>	"	+	+	+	<i>Trichoderma lignorum</i>	"	+	-	-
<i>Aspergillus terreus</i> ...	"	+	+	+	<i>Ghiobotrys albo-viridis</i>	"	+	+	+
<i>Aspergillus nidulans</i> .	Woods	-	-	-	<i>Acrostalagmus albus</i>	Pasture	+	+	+
<i>Aspergillus niger</i>	"	-	-	-	<i>Alternaria</i> No. 1....	"	+	+	+
<i>Aspergillus conicus</i> ..	"	-	-	-	<i>Alternaria</i> No. 2....	"	+	+	+
<i>Aspergillus Sydowi</i> ..	"	-	+	+	<i>Alternaria</i> No. 3....	"	+	+	+
<i>Aspergillus olivaceus</i> .	Pasture	-	-	-	<i>Alternaria</i> No. 4....	"	+	+	+
<i>Penicillium decumbens</i>	"	+	+	+	<i>Alternaria</i> No. 5....	Woods	+	+	+
<i>Penicillium roseum</i> ..	"	-	-	-	<i>Coniothyrium</i>	"	-	-	-
<i>Penicillium atramentosum</i>	Woods and Pasture	+	+	-	<i>Cephalosporium</i>	"	+	+	+
<i>Penicillium biforme</i> ..	Pasture	-	-	-					

SUMMARY

In this survey of virgin soils thirty species of soil fungi were found and identified, five of which are described as new species, viz., *Absidia subpoculata*, *Mucor mirus*, *Mucor echinulatus*, *Cunninghamella verticillata*, and *Hormodendrum nigrescens*. Of five species of *Mucor* found two were new species; there were five

species of *Hormodendrum*, one of which was new; there were eight species of *Aspergillus* found, one of which, *A. fumigatus*, occurred in large numbers; there were found seven species of *Penicillium*; one species of *Coniothyrium*, unidentified, was found, once six and once twelve inches below the surface. Of the thirty identified species only three, *Penicillium atramentosum*, *Hormodendrum cladosporioides* and *Acrostalagmus albus*, were found common to both woodland and open pasture land.

Many of the species were found capable of growing on a synthetic medium with cellulose as the only source of carbon. Half the species of *Aspergillus* could ferment cellulose, while five of the species of *Penicillium*, of the seven found, showed cellulose-fermenting power to a considerable degree. The species of *Hormodendrum* and *Alternaria* seem to be almost constant in their ability to ferment cellulose.

There seems to be a marked diminution in the frequency of occurrence of fungi with increase in depth beyond the first three inches, in virgin soils, but the lower depths yield their proportion of the new species; four of the five new forms found were isolated from six to twelve inches below the surface.

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PLATE 24

1. *Absidia subpocolata*: *a*, sporangium, $\times 700$; *b*, columella, $\times 700$; *c*, branching of sporangium, and septum near the tip and bearing a columella with a collar remaining, $\times 700$; *d*, spores, $\times 1400$; *e*, young sporangiophore and sporangium developing, $\times 700$.

2. *Mucor mirus*: *a*, sporangiophore and sporangium, $\times 1400$; *b*, columella, $\times 1400$; *c*, spore, $\times 1400$; *d*, chlamydospores, $\times 700$.

3. *Mucor echinulata*: *a*, sporangiophore showing monopodial branching, $\times 450$; *b*, sporangium, $\times 450$; *c*, columella, $\times 700$; *d*, chlamydospore, $\times 700$.

4. *Cunninghamella verticillata*: *a*, upper end of the conidiophore showing the terminal vesicle, $\times 350$; *b*, portion of the conidiophore showing the entire system of lateral branches, $\times 350$; *c*, lateral branch with spores attached, $\times 450$; *d*, spore from the terminal vesicle, $\times 900$; *e*, spore from a lateral vesicle, $\times 900$.

5. *Hormodendrum nigrescens*: conidial head and spores, $\times 700$.

6. *Mucor hiemalis*: *a*, sporangium, $\times 700$; *b*, columella showing some of the basal collar, $\times 450$.

7. *Mucor Ramannianus*: *a*, sporangium and sporangiophore, showing the thick stout sporangiophore, $\times 1400$; *b*, columella with some of the basal collar, $\times 1400$; *c*, spores showing the angular appearance, $\times 1400$; *d*, chlamydospores, $\times 700$.

8. *Zygorrhynchus Moelleri*: *a*, sporangiophore, $\times 700$; *b*, columella, $\times 700$; *c*, mature zygosporangium, $\times 450$; *d*, developing zygosporangium, $\times 450$.

9. *Chaetomium bostrychodes*: *a*, diagrammatic sketch of the perithecium, showing the asci; *b*, asci, $\times 450$; *c*, spores, $\times 700$.

10. *Aspergillus versicolor*: vesicle, sterigmata, and spores detached, $\times 700$.

PLATE 25

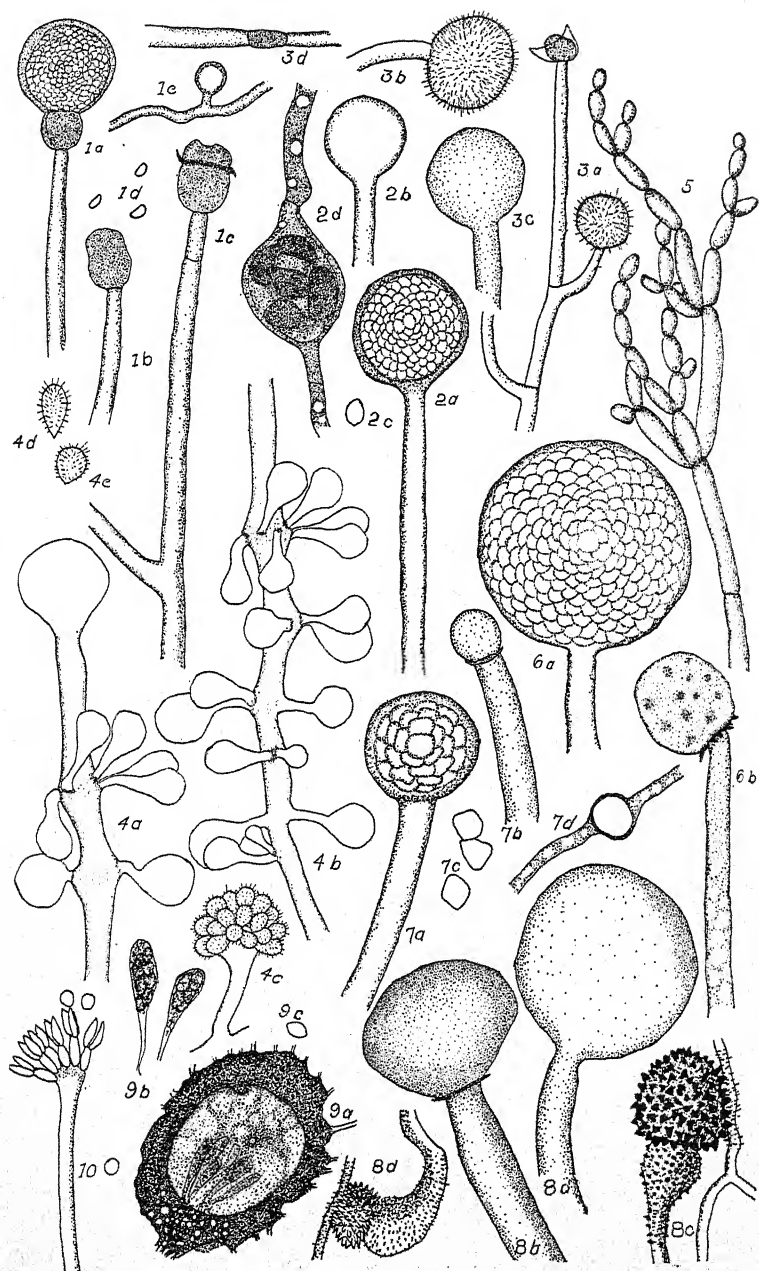
11. *Aspergillus fumigatus*: *a*, upper part of conidiophore, vesicle, and sterigmata, $\times 700$; *b*, diagrammatic sketch of the conidial head showing columnar appearance, $\times 450$.

12. *Aspergillus terreus*: *a*, lateral branching of hyphae, $\times 450$; *b*, diagrammatic sketch of vesicle and sterigmata with chains of conidia, $\times 700$.

13. *Aspergillus nidulans*: vesicle and sterigmata, $\times 700$.

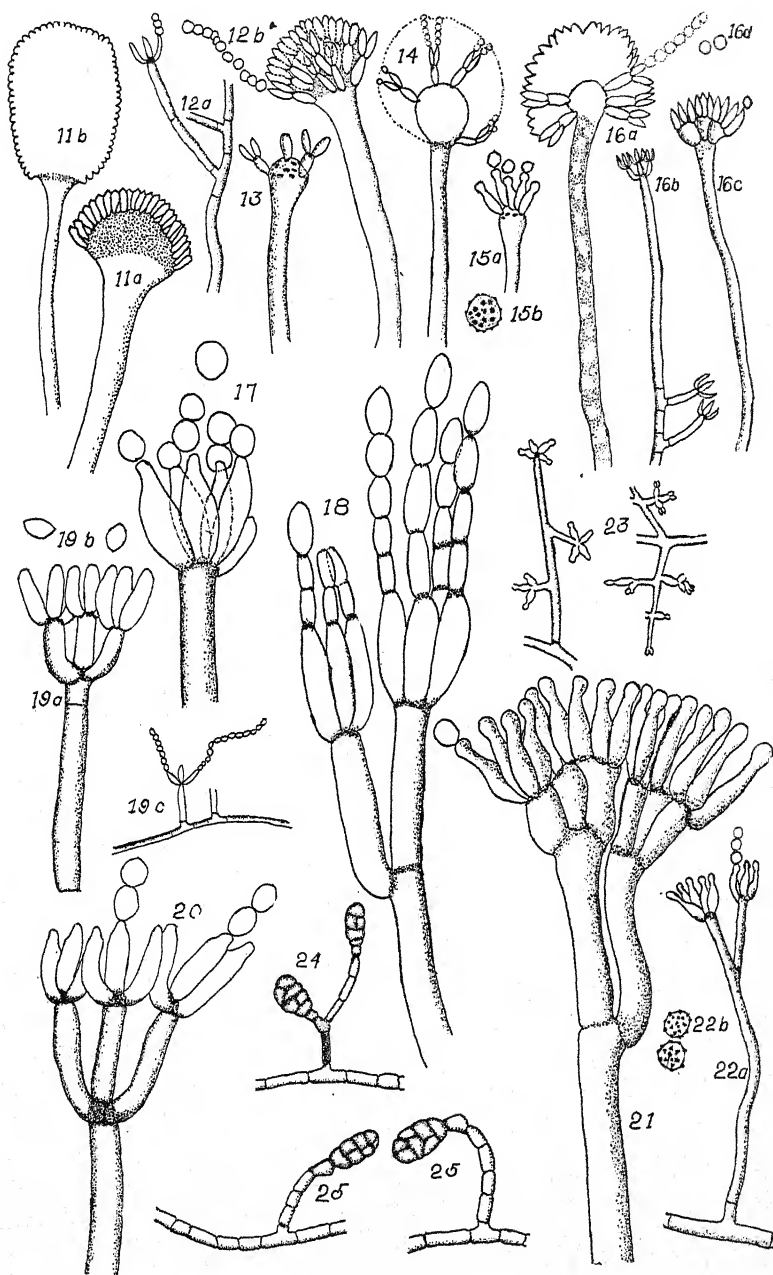
14. *Aspergillus niger*: diagrammatic sketch of conidial head, vesicle, sterigmata, and spores, $\times 700$.

15. *Aspergillus conicus*: *a*, vesicle showing the tuft-like appearance of the sterigmata, $\times 700$; *b*, spore, $\times 1400$.



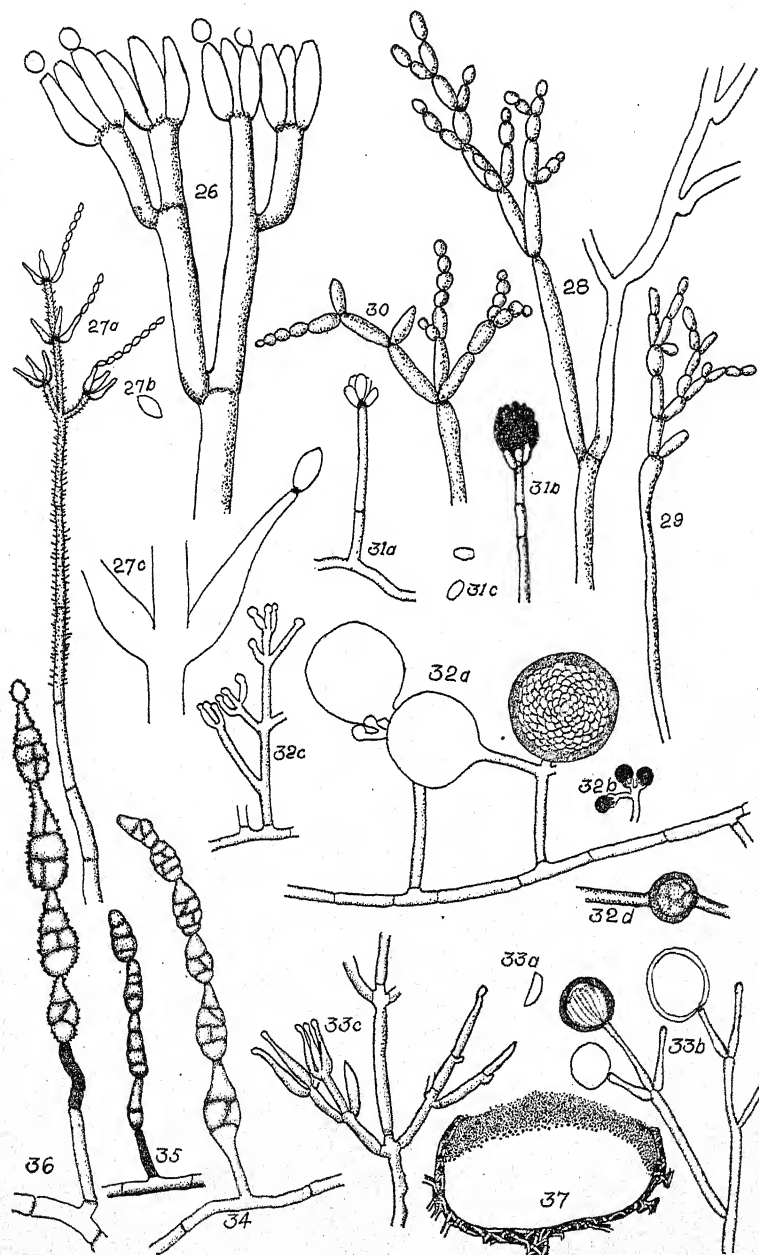
FUNGI OF VIRGIN SOILS



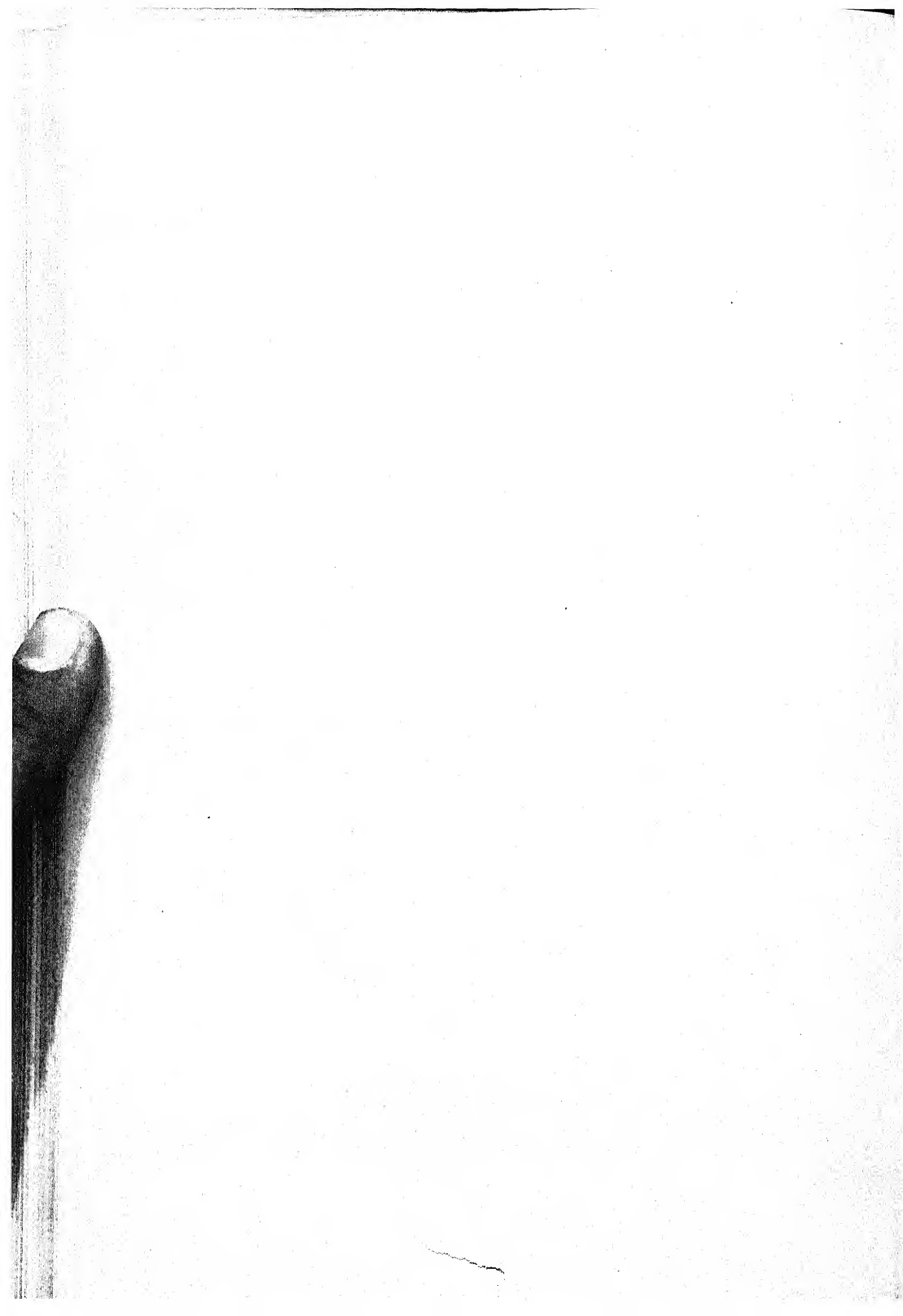


FUNGI OF VIRGIN SOILS





FUNGI OF VIRGIN SOILS



16. *Aspergillus Sydowi*: *a*, normal vesicle, conidial head, and sterigmata (diagrammatic), $\times 700$; *b*, lateral branches bearing few sterigmata without a vesicle, $\times 450$; *c*, conidial head showing multiple secondary sterigmata, $\times 700$; *d*, conidia, $\times 700$.
17. *Aspergillus olivaceus*: conidial head, $\times 1400$.
18. *Penicillium decumbens*: conidial head, $\times 1400$.
19. *Penicillium roseum*: *a*, conidial head, $\times 1400$; *b*, conidia, $\times 1400$; *c*, lateral branching, $\times 450$.
20. *Penicillium biforme*: conidial head, $\times 1400$.
21. *Penicillium atramentosum*: conidial head, $\times 1400$.
22. *Penicillium echinatum*: *a*, conidiophore, $\times 700$; *b*, conidia, $\times 1400$.
23. *Trichoderma lignorum*: branches of the conidiophore, $\times 450$.
24. *Alternaria* (No. 2): conidiophores and attached conidia, $\times 450$.
25. *Alternaria* (No. 5): conidiophores and conidia, $\times 450$.

PLATE 26

26. *Penicillium chrysogenum*: conidial head, $\times 1400$.
27. *Spicaria elegans*: *a*, conidiophore and sterigmata, $\times 450$; *b*, conidia, $\times 900$; *c*, whorled arrangement of the sterigmata as lateral branches on the conidiophore, $\times 1400$.
28. *Hormodendrum cladosporioides*: branched conidiophore and conidial head, $\times 700$.
29. *Hormodendrum olivaceum*: conidial head and spores, $\times 450$.
30. *Hormodendrum viride*: conidial head and conidia, $\times 700$.
31. *Stachybotrys cylindrospora*: *a*, conidiophore attached to the sterile creeping hyphae, $\times 450$; *b*, conidiophore and conidial head, $\times 450$; *c*, conidia, $\times 450$.
32. *Gliobotrys albo-viridis*: *a*, conidiophores as lateral branches bearing mature masses of spores, $\times 450$; *b*, diagrammatic sketch of a whorl of terminal branches and the slimy mass of conidia, $\times 140$; *c*, secondary branching and immature fruiting bodies, $\times 450$; *d*, chlamydospore, $\times 700$.
33. *Acrostalagmus albus*: *a*, conidia, $\times 450$; *b*, verticillate conidiophore bearing mature conidia, $\times 450$; *c*, club-shaped sterigmata, $\times 700$.
34. *Alternaria* (No. 1): conidial chain, $\times 450$.
35. *Alternaria* (No. 3): conidial chain, $\times 450$.
36. *Alternaria* (No. 4): conidial chain, $\times 450$.
37. *Coniothyrium* (species not determined): diagrammatic sketch of a cross section of the pycnidium.

(Magnifications based on original drawings which have been reduced one-half.)

NOTES ON SOME RUSTS OF COLOMBIA

F. D. KERN AND C. E. CHARDON

Our knowledge of the rust flora of Colombia is based chiefly on the work of Dr. Eugène Mayor, who in 1913 published an excellent paper entitled "Contribution à l'étude des Uredinees de Colombie" (Mem. Soc. Neuch. Sci. Nat. 5: 442-599). In that important contribution 158 species were reported of which 84 were described as new. According to Mayor only six species had been reported from Colombia prior to 1913. His report of that year included only two of the six previously reported. Mayor's paper was based on collections made in 1910.

The following notes are based on collections made by the junior author during April, May, and June, 1926. In the data given, the collector's name and the year 1926 are omitted in order to avoid repetition since they are the same in all cases. Here are recorded 33 species. Of this number, 15 are new to the Mayor list and four, *Ravenelia Mainsiana* Arth. & Holw. on *Mimosa albida* H. & B., *Coleosporium domingense* (Berk.) Arth. on *Plumiera*, *Uredo Zeugitis* Arth. & Holw. on *Zeugites mexicana* (Kunth.) Trin., and *Puccinia abrepta* Kern on *Cyperus*, are new to South America. A fifth species, *Puccinia pallescens* Arth. on *Zea Mays* L., has been reported previously from Trinidad but this is the first record from the mainland of South America.

In the following list the 18 species which were included in the Mayor list are marked with an asterisk for ready identification. It should be pointed out that for 10 of the 18 we are not using the same names which Mayor used but full notes are included in each case so that there need be no confusion. These changes are due in some cases to transfers to different genera and in others to the combining of forms which have been provided with separate names.

In the Mayor list the species were distributed among 13 genera including the form-genera *Aecidium* and *Uredo*. In our list are only nine genera but of this number three, *Cerotelium*,

Dicheirinia, and *Tranzschelia*, are new to the Mayor list. *Cionothrix* is a new name but the species we are referring to this genus appeared under *Cronartium*. We have three species to include under *Uredo* but none under *Aecidium*. Our list also includes one species, *Puccinia levis* (Sacc. & Bizz.) Magn., which was known from Colombia prior to the report of Mayor and which was not rereported by him.

We are indebted to Doctor H. A. Gleason, of the New York Botanical Garden, Doctor P. C. Standley, of the U. S. National Museum, Professor A. S. Hitchcock and Mrs. Agnes Chase, of the U. S. Department of Agriculture, for aid in the determination of hosts.

1. *COLEOSPORIUM ELEPHANTOPODIS (Schw.) Thüm. Myc. Univ. 953. 1878.

On *Elephantopus mollis* H.B.K., near Titiribi, Dept. Antioquia, May 14, 33.

2. COLEOSPORIUM DOMINGENSE (Berk.) Arth. Am. Jour. Bot. 5: 329. 1918.

Coleosporium Plumierae Pat. Bull. Soc. Myc. Fr. 18: 178. 1902.

On *Plumiera* sp., Independence Park, Medellin, Dept. Antioquia, April 21, 13.

This species is known from a number of the West India Islands and from Panama and Guatemala. This is apparently the first report from South America. The specific name here used is founded on *Uredo domingense* Berk. Ann. Mag. Nat. Hist. II. 9: 200. 1852.

3. *CEROTELIUM DESMIUM (Berk. & Br.) Arth. N. Am. Fl. 7: 698. 1925.

On *Gossypium barbadense* L., Magdalena River, Santa Cruz, Dept. Bolivar, June 19, 170.

Gossypium peruvianum Cav., Independence Park, Medellin, Dept. Antioquia, April 21, 15.

This is a common rust known in various parts of the world on species of cotton. It was reported by Mayor under the name *Uredo Gossypii* Lagerh. It has been referred also to the genus *Kuehneola*.

4. CEROTELIUM FICI (Cast.) Arth. Bull. Torrey Club 44: 509. 1917.

On *Ficus Carica* L., Km. 21, Tranvia de Oriente, Dept. Antioquia, May 18, 57.

This rust was originally described as a *Uredo* and has since been referred both to *Kuehneola* and *Physopella*.

5. *CIONOTHRIX PRAELONGA (Wint.) Arth. N. Am. Fl. 7: 124. 1907.

On *Eupatorium* sp., Magdalena River, near Barranca, Dept. Santander, June 17, 140.

This species appears in the Mayor list as *Cronartium praelongum* Wint. (Hedwigia 26: 24. 1887). It is known from Guatemala, Costa Rica, Panama, and Veracruz on various species of *Eupatorium*, and from Brazil on an undetermined composite.

6. *RAVENELIA INGAE (P. Henn.) Arth. N. Am. Fl. 7: 132. 1907.

On *Inga edulis* Mart., near Venecia, Dept. Antioquia, May 26, 110.

Inga sp., near R. R. Station at Piedecuesta, Dept. Antioquia, May 25, 90.

This is an interesting macrocyclic species with pycnia, uredinoid aecia (primary uredo), uredinia, and telia. The spores of the uredinoid aecia are rather striking in having longitudinal striations. This stage was named twice before its telial connection was known, once by Mayor as *Uromyces porcensis* (l.c. p. 459) and again by Arthur as *Ravenelia Whetzelii* (Mycologia 9: 64. 1917). It is this stage which is present in our material.

7. RAVENELIA MAINSIANA Arth. & Holw. Am. Jour. Bot. 5: 426. 1918.

On *Mimosa albida* H.B.K., Fair Grounds, Medellin, Dept. Antioquia, April 18, 4.

Heretofore this species has been known only from the type locality in Guatemala. This species of *Mimosa* was not in the Mayor list.

8. *DICHEIRINIA BINATA* (Berk.) Arth. N. Am. Fl. 7: 147. 1907.
On *Erythrina glauca* Willd., Fair Grounds, Medellin, Dept.
Antioquia, April 18, 6.

The uredinal stage of this species, which is the one more often collected, was named *Uredo Cabreriana* by Kern and Kellerman in 1907 (Jour. Myc. 13: 25) without recognizing its true generic connection. It is known from several localities in Central America and the West Indies and has been reported previously from South America. It is one of the commonest rusts in the vicinity of Medellin.

9. *TRANZSCHELIA PUNCTATA* (Pers.) Arth. Résult. Sci. Congr. Bot. Vienne 340. 1906.
Puccinia Pruni-spinosae Pers. Syn. Fung. 226. 1801.
On *Amygdalus Persica* L., near Country Club, Medellin, Dept.
Antioquia, May 8, 28.

10. **UROMYCES APPENDICULATUS* (Pers.) Fries, Summa Veg. Scand. 514. 1849.

On *Phaseolus lunatus* L., Independence Park, Medellin, Dept.
Antioquia, May 21, 81.

Phaseolus vulgaris L., Medellin, April 24, 21.

This species is included by Mayor (p. 462) but *Vigna luteola* is the only host mentioned.

11. **UROMYCES BIDENTICOLA* (P. Henn.) Arth. Mycologia 9: 71. 1917.

On *Bidens pilosa* L., Km. 21, Tranvia de Oriente, Dept.
Antioquia, May 18, 61; near Fredonia, Dept. Antioquia,
May 26, 104.

This species was reported by Mayor on this host and also on *Bidens bipinnata* L. and *B. squarrosa* H.B.K. but he called it *Uromyces Bidentis* Lagerh. Subsequent investigations have shown that *U. Bidentis* is a microcyclic species while *U. bidenticola* possesses uredinia. All of the Colombian specimens have uredinia and are properly referred to *U. bidenticola*.

12. **UROMYCES COLUMBIANUS* Mayor, Mem. Soc. Neuch. Sci. Nat. 5: 467. 1913.

On *Melanthera aspera* (Jacq.) L. C. Rich., Candela Road from Cauca Valley to "La Suiza," Dept. Antioquia, May 28, 120.

13. *UROMYCES LEPTODERMUS* Syd.; Syd. & Butler, Ann. Myc. 4: 430. 1906.

On *Panicum barbinode* Trin., Fair Grounds, Medellin, Dept. Antioquia, April 18, 5.

According to Arthur (Proc. Am. Phil. Soc. 44: 207, 1925) this species is known from South America by two collections from Peru, one by Rose in 1914 and one by Holway in 1920.

14. **UROMYCES MEGALOSPERMUS* Speg. Fungi Argent. 218. 1899.

On *Tessaria integrifolia* R. & P., Fair Grounds, Medellin, Dept. Antioquia, April 18, 3.

15. **UROMYCES PROËMINENS* (DC.) Pass. Rab. Fungi Eur. 1795. 1873.

On *Chamaesyce hirta* (L.) Millsp., Medellin, Dept. Antioquia, April 24, 22; Hacienda Marsella, Cauca Valley, Dept. Antioquia, May 27, 116.

This species was included by Mayor under the name *Uromyces euphorbiicola* (Berk. & Curt.) Tranzschel (Ann. Myc. 8: 8, 1910) which we regard as a synonym. He did not include this host.

16. *PUCCINIA ABREPTA* Kern, Mycologia 11: 140. 1919.

On *Cyperus* sp. (possibly *C. caracasanus* Kunth.), Hacienda Marsella, Cauca Valley, Dept. Antioquia, May 27, 115.

This appears to be the first report of this species from South America. Our specimen agrees well with the type, which is from Costa Rica, especially in having the pores of the urediniospores covered with a swollen hyaline cuticle.

17. **PUCCINIA CENCHRI* Diet. & Holw.; Holw. Bot. Gaz. 24: 28. 1897.

On *Cenchrus echinatus* L., Magdalena River, Santa Cruz, Dept. Bolivar, June 19, 169.

This species has been reported also from Brazil (see Arth. Proc. Am. Phil. Soc. 44: 158, 1925).

18. *PUCCINIA CRASSIPES Berk. & Curt. Grevillea 3: 54. 1874.

On *Ipomoea* sp., Candela Road from Cauca Valley to "La Suiza," Dept. Antioquia, May 28, 121.

Only aecia are present in this specimen. The same is true of the specimen reported by Mayor (l.c. p. 488) which he calls *Puccinia Ipomoeae-panduratae* (Schw.) Syd. Arthur has shown that the Schweinitz name *Aecidium Ipomoeae-panduranae* was founded on an *Albugo*. The proper name for the *Ipomoea* rust seems to be as above.

19. PUCCINIA EVADENS Harkn. Résult. Sci. Congr. Bot. Vienne 343. 1906.

On *Baccharis cassinaefolia* DC., Km. 21, Tranvia de Oriente, Dept. Antioquia, May 18, 64.

In the Mayor list there are seven different species of rust reported on as many species of the genus *Baccharis*. It is with hesitation that we report still another, for *Puccinia evadens* Harkn. is not in this list, although it has been reported from South America. On the other hand ours is a different species of host and the characters agree so well with *Puccinia evadens* that the present reference seems entirely justifiable.

20. PUCCINIA GRAMINIS Pers. Neues Mag. Bot. 1: 119. 1794.

On *Agrostis perennans* (Walt.) Tuckerm., Km. 21, Tranvia de Oriente, Dept. Antioquia, May 18, 66.

Arthur reports (Proc. Am. Phil. Soc. 44: 178, 1925) twelve hosts from South America for this common grass rust. He comments that this is not a long list for a rust that is so common in the north temperate zone. *Agrostis perennans* is not in the Arthur list.

21. *PUCCINIA HETEROSPORA Berk. & Curt.; Berk. Jour. Linn. Soc. 10: 356. 1869.

On *Sida spinosa* L., Medellin, Dept. Antioquia, April 24, 20.

22. PUCCINIA LEVIS (Sacc. & Bizz.) Magn. Ber. Deuts. Bot. Ges. 9: 190. 1891.

On *Axonopus scoparius* (Fl.) Hitchc., Finca Mirasol, near Sabaletas, Dept. Antioquia, May 20, 72.

Paspalum pilosum Lam., Finca Mirasol, near Sabaletas, Dept. Antioquia, May 20, 75.

A fairly common rust in southern United States, Central America, the West Indies, and northern South America.

23. *PUCCINIA MELAMPODII Diet. & Holw.; Holw. Bot. Gaz. 24: 32. 1897.

Puccinia Synedrellae P. Henn. Hedwigia 37: 277. 1898.

Puccinia Eleutherantherae Diet. Ann. Myc. 7: 354. 1909.

Puccinia Wedeliae Mayor, Mem. Soc. Neuch. Sci. Nat. 5: 528. 1913.

On *Synedrella nodiflora* (L.) Gaertn., Fredonia, Dept. Antioquia, May 25, 96.

Wedelia caracasana DC., Medellin, Dept. Antioquia, May 7, 27.

It is our opinion that the microcyclic rusts on *Eleutheranthera*, *Synedrella*, and *Wedelia* are the same species and that they are referred properly as here indicated.

24. PUCCINIA PALLESCENS Arth. Bull. Torrey Club 46: 111. 1919.

On *Zea Mays* L., near Venecia, Dept. Antioquia, May 26, 109.

This species has pale yellow uredinia and nearly colorless walls in the urediniospores as compared with the cinnamon-brown uredinia and golden- or cinnamon-brown walls of the common corn rust, *Puccinia Sorghi*. Arthur has reported *Puccinia pallescens* from Trinidad (Am. Phil. Soc. 44: 156) but this appears to be the first report from the mainland of South America.

25. *PUCCINIA POLYGONI-AMPHIBII Pers. Syn. Fung. 227. 1801.

On *Persicaria punctata* (Ell.) Small (*Polygonum acre* H.B.K.), near Medellin, Dept. Antioquia, April 24, 19; near Titiribi, Dept. Antioquia, May 14, 32.

26. PUCCINIA PSIDII Wint. Hedwigia 23: 171. 1884.
On *Jambos Jambos* (L.) Millsp. (*Eugenia Jambos* L.), Independence Park, Medellin, Dept. Antioquia, April 21, 18; Poblado Sorrento, Dept. Antioquia, May 16, 45.
27. *PUCCINIA ROTUNDATA Diet. Hedwigia 36: 32. 1897.
On *Vernonia patens* H.B.K., Candela Road from Cauca Valley to "La Suiza," Dept. Antioquia, May 28, 123.
This rust was reported by Mayor (l.c. p. 511) on the same host, under the name *Puccinia rugosa* Speg. (Anal. Soc. Ci. Argent. 17: 92, 1884). Although this is an older name than *Puccinia rotundata* it is not valid as there is a *Puccinia rugosa* Billings, 1871, which is another thing.
28. PUCCINIA RUELLIAE (Berk. & Br.) Lagerh. Tromsö Mus. Aarsh. 17: 71. 1895.
On *Blechnum Blechnum* (L.) Millsp., Road from Medellin to Itagui, Dept. Antioquia, April 18, 8.
A common rust in tropical regions of both hemispheres.
29. *PUCCINIA SOLANITA (Schw.) Arth. Mycologia 14: 19. 1922.
Puccinia solanicola Mayor, Mem. Soc. Neuch. Sci. Nat. 5: 505. 1913.
On *Solanum* sp., Itagui, Dept. Antioquia, April 18, 10.
The Schweinitz specific name *solanita* was founded on a specimen from Surinam and dates back to 1853. We believe that Mayor's *Puccinia solanicola* is the same and must become a synonym as indicated.
30. *PUCCINIA SORGHII Schw. Trans. Am. Phil. Soc. II. 4: 295. 1832.
Puccinia Maydis Bereng. Atti Sci. Ital. 6: 475. 1845 (hyponym).
On *Zea Mays* L., Itagui, Dept. Antioquia, April 18, 9; Km. 21, Tranvia de Oriente, Dept. Antioquia, May 18, 60.
Apparently a common rust wherever Indian corn is grown.
31. UREDO CHERIMOLIAE Lagerh. Bull. Soc. Myc. Fr. 11: 215. 1895.
On *Annona Cherimolia* Mill., Medellin Park, Dept. Antioquia, April 16, 2; near Titiribi, Dept. Antioquia, May 28, 126.

This species is known from Ecuador and Florida on this host, and from Cuba, Florida, and Yucatan on other species of the genus *Annona*.

32. *UREDO CUPHEAE P. Henn. Hedwigia 34: 99. 1895.

On *Parsonsia Pinto* (Vand.) Heller (*Cuphea Balsamona* C. & S.), near Titiribi, Dept. Antioquia, May 14, 31; Km. 21, Tranvia de Oriente, Dept. Antioquia, May 18, 69.

This species is known also from the West Indies and Brazil.

33. UREDO ZEUGITIS Arth. & Holw.; Arth. Am. Jour. Bot. 5: 538. 1918.

On *Zeugites mexicana* (Kunth.) Trin. (*Senites mexicana* Hitchc.), Km. 21, Tranvia de Oriente, Dept. Antioquia, May 18, 52.

This appears to be the first report of this species for South America and also the first report for this species of host. It is known from Guatemala on *Zeugites Hartwegi* Fourn.

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ON THE OCCURRENCE OF BIFLAGELLATE SWARM CELLS IN CERTAIN MYXOMYCETES

FRANK A. GILBERT

(WITH 2 TEXT FIGURES)

While the swarm cells of Myxomycetes have almost invariably been described as unflagellate, occasionally swimmers with two flagella have been reported, associated with normal swarm cells. These biflagellate forms are of two types, the first being characterized by having two flagella at the anterior end and the second by having one flagellum at each end. Swarm cells of the first type, as far as the writer has been able to ascertain, have been recorded only by DeBary¹ who observed them in a culture of the spores of *Trichia varia*. Swarm cells of the second type however, are of more frequent occurrence, Constantineau² having found them in cultures of the spores of *Dictydium cancellatum*, Durand,³ of *Enteridium Roseanum*, and DeBary,¹ of *Fuligo septica* and *Trichia varia*, in which, as above indicated, they were associated with swarm cells of the first type.

While studying spore-germination⁴ in many representative genera and species of Myxomycetes, the writer also has observed biflagellate swarm cells. Both types occurred in his cultures, which were made by sowing the myxomycetous spores in distilled water in Syracuse glasses.

Swarm cells of the first type, that is with two flagella at the

¹ Bary, H. A. De. Die Mycetozoen. Zeitschr. Wissensch. Zoologie 10: (1860).

² Constantineau, L. Ueber Entwicklungsbedingungen der Myxomyceten. Ann. Myc. 4: 495 (1906).

³ Durand, E. J. Notes on the Germination of *Enteridium Roseanum*. Bot. Gaz. 19: (1894).

⁴ The writer is greatly indebted to Dr. William H. Weston, Jr., for his help during the course of the work and also for invaluable aid in the preparation of the manuscript.

anterior end, were found in cultures of one gathering of *Stemonitis fusca* from the Cambridge region. About twenty-five per cent of the swarm cells from this gathering had two flagella while the remaining seventy-five per cent were normal. The second flagellum was not apparent in living specimens except under the highest powers of the microscope (TEXT FIG. 1, *e-f*), but could easily be seen when the organisms were killed and stained. A number of Van Tieghem cell cultures were made and in each was placed a single spore taken from a sporangium of the previously mentioned gathering. In a few of these cultures, the swarm cell that emerged had two flagella at one end, indicating that this type is truly myxomycetous and, since other gatherings of *Stemonitis fusca* developed only normal swarm cells, must be considered as merely an abnormal form.

Swarm cells of the second type, that with a flagellum at each end, were found a number of times by the writer. They occurred sporadically in cultures of various genera and species of Myxomycetes, but were not present in cultures of *Enteridium Rozeanum* in which species they had previously been reported by Durand. Because of the irregularity of their occurrence, it seemed of interest to determine definitely their nature and origin. Two explanations seemed possible, first, that they were truly myxomycetous, either aberrant swarm cells of the species sown or normal swarm cells of some contaminating species, and second, that they were Protozoa which in some manner had made their way into the cultures. Protozoa of various sorts are not infrequently found in myxomycete cultures, since their cysts, like the spores of bacteria and fungi, may be blown about and come to rest on sporangia; or according to Pinoy⁵ may even be carried up by the rising plasmodium, and incorporated with them during their formation. As a result, these cysts, as well as various other foreign bodies, may eventually be introduced in the cultures with the spores of the Myxomycete that is being studied.

As far as the general characters are concerned, swarm cells of this type seem to correspond very closely to normal swarm cells

⁵ Pinoy, E. Rôle des Bactéries dans le Développement de certains Myxomycètes. Ann. Inst. Pasteur 21: 622 (1907).

in size, color and general shape (TEXT FIG. 1, g-i). The nucleus, however, which in normal swarm cells of the Myxomycetes is usually apparent at the anterior end below the base of the flagellum (TEXT FIG. 1, a-c), appears, in these biflagellate forms,

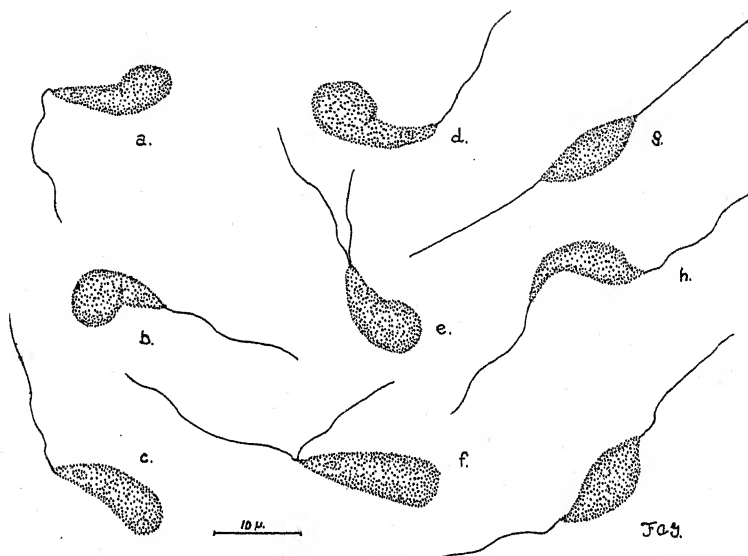


FIG. 1. a. *Hemitrichia clavata*. Swarm cell, showing its form during the rotating movement which is simulated by the protozoan, *Cercomonas*; b, c. *Trichia affinis*. b. Swarm cell, showing form during rotating movement. c. Swarm cell, showing form during creeping movement which is not simulated by *Cercomonas*; d-f. *Stemonitis fusca*. d. Normal swarm cell. e, f. Swarm cells from the same gathering as d, with two flagella at the anterior end; g-i. *Cercomonas longicauda*. g. Protozoan, showing form during the smooth gliding movement. h, i. Protozoan, showing form during the rotating movements.

to be nearer the center of the cell and is distinguished with great difficulty. Their movements, owing to the characteristic rotation which they frequently exhibit, simulate very closely the similar phenomenon so frequently observable in myxomycetous swarm cells generally. The latter, however, are easily differentiated by the fact that they frequently pass to a creeping or vermicular stage (TEXT FIG. 1, c), which has never been observed in biflagellate "swarm cells" of the type under consideration. The biflagellate forms, on the other hand, are clearly distinguished

from the normal myxomycetous swarm cells by a characteristic motion peculiar to themselves. They often glide smoothly forward in an absolutely straight line, with the flagella stretched out from each end (TEXT FIG. 1, *g*), a movement which, as far as has been observed, never occurs among myxomycetous swarm cells. These differences in methods of progression clearly differentiate the two organisms when they are examined under the higher powers of the microscope.

In order to study them further, a number of the biflagellate individuals of this type were separated from cultures of *Hemitrichia clavata*, in which they had appeared, placed in sterile watch glasses in water, a little autoclaved hay added, and the whole set aside for a few days. At the end of this time, in the original cultures, the normal uniflagellate *Hemitrichia* swarm cells, which are very susceptible to unfavorable environmental conditions, had become microcysts or had changed to myxamoebae; while the forms with a flagellum at each end, in all of the original cultures in which they occurred, as well as in the autoclaved hay cultures separated from them, in contrast to the myxomycetous swarm cells associated with them, had not modified their characteristics in any respect. Indeed, in the course of a number of experiments, they were found to form cysts only under conditions, for example, of extreme heat or dryness.

The most striking difference between the two forms, however, is in the method of division. All myxomycetous swarm cells which were observed in the many cultures of the writer, divided in the normal manner⁶ by retracting the flagellum and rounding off, before the separation in two parts (TEXT FIG. 2, *a-c*). The biflagellate forms, on the contrary, accomplished their division without any such retraction, one of the persistent flagella being eventually attached to each daughter cell (TEXT FIG. 2, *d-i*). The process by which this division takes place is as follows: the original cell slowly elongates and a slight constriction appears

⁶ F. X. Skupienski in his "Recherches sur le cycle évolutif de certains Myxomycètes," Paris (1922), mentions a division of the swarm cells of *Didymium nigripes* by longitudinal fission which is anomalous among the Myxomycetes.

at the middle (TEXT FIG. 2, *e*); the constriction gradually becomes more marked until the cell at this point is about one fourth of its original diameter (TEXT FIG. 2, *f*); the two halves then gradually draw apart and as they do so remain connected

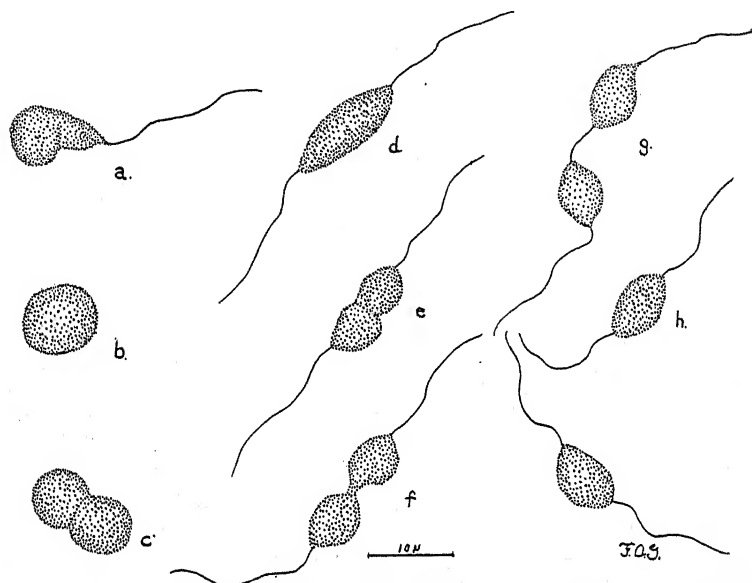


FIG. 2. *a-c. Hemitrichia clavata*. *a*. Swarm cell. *b*. Swarm cell just before division, with the flagellum absorbed. *c*. Swarm cell during division; *d-i. Cercomonas longicauda*. *d*. Protozoan before division. *e-i*. Stages in division, showing the flagella, which are not absorbed but remain active during the process.

by a slender protoplasmic thread (TEXT FIG. 2, *g*), which soon breaks (TEXT FIG. 2, *h, i*), and each daughter cell, supplied with a new flagellum, swims away in its characteristic biflagellate condition. This division is of the type known to occur among the monad flagellates in certain genera such as *Cercomonas*⁷ and also in the Labyrinthulales, an order generally regarded as belonging to the more primitive Mycetozoa. This order was investigated by Zopf⁸ who found that "die Amöbæ sich

⁷ Dallinger & Drysdale. Researches on the Life History of a *Cercomonad*. Mon. Mic. Jour. 10: (1873).

⁸ Zopf, W. Zur Kenntniss der Labyrinthuleen, einer Familie der Mycetozoen. Beiträge zur Physiologie und Morphologie niedriger Organismen. Leipzig (1873).

ziemlich bedeutend streckt und dann etwa in der Mitte einschnürt, worauf beide Theile auseinander rücken, aber durch einen Hyaloplasmastrang verbunden bleiben." ⁹ Zopf also found that the flagella of the swarm cells of that order fuse with one another or with the body of an adjacent swarm cell almost immediately after germination ⁸ to form a net plasmodium.

It would seem, therefore, that the second of the two possible explanations of their presence, which has already been suggested above, was likely to be the true one, namely that they should be regarded as protozoan contaminants, accidentally introduced. That they cannot be referred to any member of the Labyrinthulales seems indicated by their failure to show the slightest tendency to form a net plasmodium. On comparing their characters with those of the various well-known types of Protozoa, they appear to correspond in their structure, behavior, and methods of reproduction to *Cercomonas longicauda* Duj., ¹⁰ a monad which seems to be common in moist vegetable materials, like decaying wood. For a verification of this determination, the writer is indebted to Dr. J. A. Dawson of the Zoological Department of Harvard University.

Since neither of the three authors above cited, who have reported the occurrence of bipolar swarm cells, records any observations on their division, it cannot be definitely assumed that they were dealing with structures identical with those studied by the writer. In view, however, of their frequent

⁹ This similarity of division presumably indicates a close relationship between the Monads and the Labyrinthulales. In the latter group, however, the cells partly fuse into what Zopf calls a "Fadenplasmodium" and eventually form sori of spores, thus throwing their true affinity with the higher Myxomycetes, between the Monads and which they possibly form a connecting link. Some authors, however, are of the opinion that the resemblance between the net plasmodium of the Labyrinthulales and the true plasmodium of the Myxogastrales is entirely superficial and shows no relationship whatsoever between the two orders.

¹⁰ Fr. Stein in "Der Organismus der Infusionsthier," 3: Leipzig (1878), shows longitudinal division in this species and transverse division in others of the same genus. The organism studied by the writer, however, agreed so closely with the description and measurements of *Cercomonas longicauda* Duj. that it can only be identified as such even though its division, conforming to that typical for the genus, does not agree with the anomalous method recorded by Stein.

appearance in numerous cultures of five or more different species, it seems highly probable that they may have been identical with the type above described. However this may be, it seems rather clearly indicated that these bodies have, in reality, no direct connection with the Myxomycetes, but are merely contaminations of accidental origin. This assumption is borne out by the fact that no such bodies have ever been seen actually to escape from a germinating spore, and further that they have occurred in cultures, for example, of decaying wood in which the presence of myxomycetous spores was at least not apparent.

It seems logical to conclude therefore, from the above investigations, that former reports of myxomycetous swarm cells with a flagellum at each end may have been based on the confusion of these Protozoa with normal swarmers.

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LOPHODERMIIUM INFECTANS MAYR A SYNONYM OF HYPODERMA ROBUSTUM TUBEUF

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(WITH 1 TEXT FIGURE)

When Mayr, in the latter part of the last century, made a trip through the forests of North America he collected or observed a number of parasites which he later named in his book (1) on these travels, but without describing the organisms, so now it is difficult and in some cases impossible to determine just what he has recorded, since the only clue to the identity of the parasite is the host on which it occurs.

Among his collections was a needle-inhabiting fungus parasitic on white fir (*Abies concolor* (Gord.) Parry) in the San Bernardino Mountains of California. The perithecia and spores which appeared on needles from 2 to 6 years old were not mature, according to Mayr's statement, in this collection made in November 1887. He named the fungus *Lophodermium infectans* n. sp. without describing it. Tubeuf (2, p. 16) who later studied some of Mayr's collections did not find this parasite among them, but did find a fungus belonging to the same family, Hysteriaceae, on a species of fir, but the material was without label. Tubeuf decided the host was *Abies concolor* and described the parasite as a new species, *Hypoderma robustum*. The genus *Hypoderma* was formerly included in *Lophodermium*.

Among duplicate collections from the Farlow Herbarium of Harvard University received by the writer through the courtesy of Professor Roland Thaxter was one labelled "*Lophodermium infectans* Mayr on *Abies concolor*. Type of Mayr. See his Waldungen." As far as can be ascertained this material came to Dr. Farlow directly from Mayr. A study of the collection shows the fungus to be the same as Tubeuf named *Hypoderma robustum*. The measurements of the spores without the gelatinous sheath as given by Tubeuf were $3 \times 30-36 \mu$, while in the

collection from the Farlow Herbarium 50 spores ranged from $3-7 \times 18-34 \mu$ with an average of $4 \times 29 \mu$, not a significant

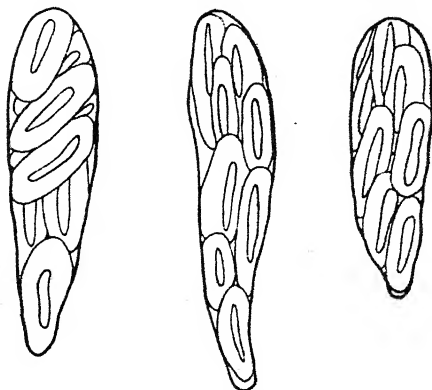


FIG. 1. Asci and spores from the collection of *Lophodermium infectum* received from the Farlow Herbarium.

difference. Asci and spores from this collection are shown in figure 1.

From the foregoing it seems highly probable that the collection studied and described by Tubeuf was originally labelled *Lophodermium infectans* by Mayr but the label was later lost. The only doubt is Mayr's statement that the fungus was not mature when he observed it, but it is not unusual when examining these fungi to find both mature and immature perithecia in the same collection. Since Mayr's name is a nomen nudum, *Hypoderma robustum* Tubeuf stands.

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- (1) Mayr, H. Die Waldungen von Nordamerika. xii + 448 pp., 16 figs., 12 pls., Munich. 1890.
- (2) Tubeuf, Carl von. Studien über die Schüttekrankheit der Kiefer. In Arbeiten aus der Biologischen Abtheilung für Land- und Forstwirtschaft am Kaiserlichen Gesundheitsamte, v. 2, no. 1, pp. i-ii + 1-160, figs. 1-32, pls. 1-7. 1901.

MISCELLANEOUS COLLECTIONS OF NORTH AMERICAN RUSTS

WILLIS R. HUNT

Listed below are fifty specimens of rusts, representing nine genera and thirty species. These were collected by the writer on various travels (not collecting trips) outside of the New England states during the past two years. Specimens of all of these collections have been deposited in the Connecticut Agricultural Experiment Station Herbarium.

In the spring and fall of 1925 the writer spent a few days in the Pocono Mountains, Matamoras, Pike County, Pennsylvania. Of the twenty-three collections made, the following rusts on the specific hosts are not listed in North American Flora:

Coleosporium Solidaginis on *Solidago neglecta*, *S. rugosa* and *S. serotina*, *Puccinia Andropogi* on *Chelone glabra*, *P. Grossulariae* on *Ribes Cynosbati*, *P. Urticae* on *Carex crinata* var. *gynandra*, *P. Violae* on *Viola conspersa*, *Uromyces hybridi* on *Trifolium hybridum*, *U. Lespedezae-procumbentis* on *Lespedeza capitata*.

In the fall of 1925 while doing some collecting in Maine, a trip was made over the line into Canada. *Puccinia graminis* on *Phleum pratense* was collected in St. Come. It is not reported in North American Flora from Quebec on this host.

A trip to Bermuda was made in the winter of 1926. In as far as the writer knows, *Uromyces Fabae* on *Vicia Faba*, and *Coleosporium Solidaginis* on *Solidago sempervirens* have never been reported from these islands. The rust on windsor bean was collected in the garden of the Agricultural Experiment Station by courtesy of Dr. Lawrence Ogilvie, Government Plant Pathologist.

The collections made at Ithaca while attending the International Congress of Plant Sciences have all been previously reported from New York by Arthur.

CAEOMA NITENS Schw. On *Rubus* sp.: I, Matamoras, Penna., May 30, '25.

COLEOSPORIUM SOLIDAGINIS (Schw.) Thüm. On *Aster cordifolius* L.: II, Enfield Falls, N. Y., Aug. 17, '26. On *Solidago arguta* Ait.: II, Taugkannock Falls, N. Y., Aug. 20, '26; II, Enfield Falls, N. Y., Aug. 17, '26. On *S. neglecta* T. & G.: II-III, Matamoras, Penna., Sept. 17, '25. On *S. rugosa* Mill.: II, Matamoras, Penna., Sept. 17, '25. On *S. sempervirens* L.: II, Bermuda, March 3, '26. On *Solidago serotina* Ait.: II, Matamoras, Penna., Sept. 17, '25.

COLEOSPORIUM DELICATULUM (Arth. & Kern) Hedgc. & Long. On *Solidago graminifolia* (L.) Salisb.: III, Matamoras, Penna., Sept. 18, '25.

GYMNOCONIA INTERSTITIALIS (Schl.) Lagerh. On *Rubus* sp.: I, Matamoras, Penna., May 30, '25.

GYMNOSPORANGIUM BERMUDIANUM (Farl.) Earle. On *Juniperus bermudiana* L.: III, Bermuda, March 3, '26.

KUEHNEOLA ALBIDA Magn. On *Rubus* sp.: II-III, Matamoras, Penna., Sept. 17, '25.

MELAMPSORA AMERICANA Arth. On *Salix* sp.: II-III, Matamoras, Penna., Sept. 18, '25; II, Ithaca, N. Y., Aug. 17, '26.

MELAMPSORA MEDUSAE Thüm. On *Populus tremuloides* Michx.: II-III, Matamoras, Penna., Sept. 18, '25.

PHRAGMIDIUM POTENTILLAE-CANADENSIS Diet. On *Potentilla canadensis* L.: III, Matamoras, Penna., Sept. 17, '25.

PUCCINIA ANDROPOGI Schw. On *Chelone glabra* L.: 0-I, Matamoras, Penna., May 30, '25.

PUCCINIA BARDANAE Corda. On *Arctium minus* Bernh.: II-III, Matamoras, Penna., May 30, '25; Sept. 18, '25; II, Ithaca, N. Y., Aug. 18, '26.

PUCCINIA CLEMATIDIS (DC.) Lagerh. On *Agropyron repens* (L.) Beauv.: II, Victor, N. Y., Aug. 21, '26.

PUCCINIA GRAMINIS Pers. On *Phleum pratense* L.: II, Matamoras, Penna., Sept. 17, '25; II, St. Come, Quebec, Sept. 25, '25; II, Victor, N. Y., Aug. 21, '26.

PUCCINIA GROSSULARIAE (Schum.) Lagerh. On *Ribes Cynosbati* L.: 0, Matamoras, Penna., May 31, '25.

PUCCINIA HELIANTHI Schw. On *Helianthus annuus* L.: II-III, Paterson, N. J., Sept. 20, '25.

PUCCINIA HIERACII (Schum.) Mart. On *Cichorium Intybus* L.: II, Middle Hope, N. Y., July 25, '25; II-III, Bermuda,

March 4, '26. On *Taraxacum officinale* Weber: II, Matamoras, Penna., May 31, '25; II, Ithaca, N. Y., Aug. 18, '26.

Puccinia LANTANAE Farl. On *Lantana involucrata* L.: III, Bermuda, March 4, '26.

Puccinia MALVACEARUM Bert. On *Althea rosea* Cav.: III, Westtown, N. Y., June 1, '25; III, Middle Hope, N. Y., July 25, '25; III, Ithaca, N. Y., Aug. 18, '26.

Puccinia MENTHAE Pers. On *Monarda fistulosa* L.: II-III, Matamoras, Penna., Sept. 18, '25.

Puccinia SUAVEOLENS (Pers.) Rostr. On *Cirsium arvense* (L.) Scop.: II, Ithaca, N. Y., Aug. 18, '26.

Puccinia THALICTRI Chev. On *Thalictrum polygamum* Muhl.: III, Enfield Falls, N. Y., Aug. 17, '26.

Puccinia URTICAE (Schum.) Lagerh. On *Carex crinata* var. *gynandra* (Schwein.) Schwein. & Torr.: II-III, Matamoras, Penna., Sept. 18, '25.

Puccinia VIOLAE (Schum.) DC. On *Viola conspersa* Reichenb.: 0-I, Matamoras, Penna., May 30, '25; *Viola cuculata* Ait.: II, Tarrytown, N. Y., July 11, '24.

Uromyces FABAE (Pers.) DeBary. On *Vicia Faba* L.: II, Bermuda, March 4, '26.

Uromyces HYBRIDI Davis. On *Trifolium hybridum* L.: III, Matamoras, Penna., May 30, '25; II, Middle Hope, N. Y., June 25, '25.

Uromyces JUNCII-EFFUSI Sydow. On *Juncus effusus* L.: III, Matamoras, Penna., June 1, '25.

Uromyces LESPEDEZAE-PROCUMBENTIS (Schw.) Curt. On *Lespedeza capitata* Michx.: III, Matamoras, Penna., Sept. 17, '25.

Uromyces MEDICAGINIS Pass. On *Medicago lupulina* L.: II, Bermuda, March 3, '26.

Uromyces TRIFOLII (Hedw. f.) Lév. On *Trifolium pratense* L.: II, Ithaca, N. Y., Aug. 18, '26; II, Victor, N. Y., Aug. 21, '26.

Uromyces TRIFOLII-REPENTIS (Cast.) Liro. On *Trifolium repens* L.: I, Matamoras, Penna., May 30, '25; II, Marlboro, N. Y., July 10, '24.

WHY THE DIFFERENCES IN PUBLISHED SPORE-SIZES?

C. H. KAUFFMAN

In a recent paper (Bull. Soc. Myc. Fr. 42: 43-50. 1926) by my good friend and honored colleague Dr. René Maire of France, that experienced and thorough mycologist has reviewed the causes that underlie the often confusing and divergent spore-measurements given by different authors for the same species. He discusses these causes under four categories:

1. Errors of determination.
2. Changes in the spore due to drying or to reagents.
3. Faults due to the technique used in measuring.
4. Innate variations of the spores themselves.

The detailed discussion of these categories is so well done and covers so many common and important cases that I am anxious that all American workers with fungi, mycologists and phytopathologists alike, should have their attention called to this valuable paper. There is scarcely one of us who has not been guilty, either unconsciously or from ignorance or in moments of haste, of neglecting one or more of the precautions which Maire here sets down.

Passing over the first category, an example of which is the mis-determination of a plant and therefore recording its spore measurements under a species name to which it does not belong, I shall briefly discuss some of the others. Two considerations are involved when one measures the spores of a herbarium specimen, *i.e.* a dried-out plant. First, the procedure used in reestablishing the normal turgidity of the spores, and, secondly, giving the reader of the paper in which such spore-measurements are printed a statement of the reagent used and the manner of its use. In all of my own published work, a fourth or a half of a one per cent solution of potassium or sodium hydroxide was invariably used with dried specimens. Unfortunately, I have scarcely ever called attention to this fact in my papers. In all

of my papers dealing with agarics since the appearance of the "Agaricaceae of Michigan," all spore-measurements of my own recorded therein were made from the fresh plant when collected, except when type specimens are mentioned, in which case the procedure involved the use of the hydroxide. Maire very properly emphasizes the importance of noting the type of reagent used.

Under his third category, he discusses: (a) the inclusion of immature spores in obtaining the range in size; (b) mistaking the central large globule of many spores for the whole spore, when its wall is very thin and transparent; (c) the use of micrometer values which are not exact; (d) errors due to the use of a defective micrometer scale. Experienced students will not generally "fall down" on the first two counts, and yet it is surprising how often spore-measurements are sent in to me with specimens, where the discrepancies which appear in our measurements are nearly always due to this lack of discrimination between young and mature spores. Maire gives an account of a very prominent French mycologist; E. Boudier, who had the unusual experience of having used a defective micrometer scale for a while. The proper calibration of one's micrometer is such a self-evident matter that it may be passed over here.

One could easily write an extensive paper on the variability of spores. Dr. Maire's remarks are well worth most careful consideration by all who are concerned in the question of spore-size. Although his discussion is limited to the Basidiomycetes, there is much that applies to spores of other groups of fungi.

The stimulus which caused Maire to review the question of spore-size came from a paper by C. E. Martin in *Bulletin de la Société Mycologique de Genève*, No. 9, 1925. The latter author is quoted as strongly advising that when a mycologist critically studies an older named plant with the microscope he should write the name and its author in the usual way, but attach in addition his own name or that of the modern author whose microscopical data agree with his, in order that there may be no question of the proper determination, at least as to microscopic points. Maire says he has used this idea for a long time in his notes. It was also a feature of the fine work of Ricken. In

my own publications, I have also for a long time both in my notes and in print employed this means of fastening my identified plant to the species as known to a particular modern author, instead of broadly writing only Schaeffer, or Bulliard, Persoon or Fries after it; for, in the latter case, my microscopic data would not be vouched for and must stand alone. These more careful modern methods, now in use by the most experienced mycologists, will do more in my judgment to stabilize the species of the Basidiomycetes than any amount of legislating.

CRYPTOGAMIC LABORATORY,
UNIVERSITY OF MICHIGAN

NOTES AND BRIEF ARTICLES

Since publishing our article on *Poronia leporina*, Dr. Roland Thaxter, of Harvard, has communicated to us two additional specimens. One was collected at Cocoanut Grove, Florida, in 1897 and the other from Sandy Run, South Carolina, in 1903. This adds something to our knowledge of the distribution of this interesting fungus and it is hoped that these notes will stimulate mycologists to make a further search for this species.

A number of models of fleshy fungi have recently been installed in the museum of the New York Botanical Garden by Dr. Fred J. Seaver. These models were made by Dr. Joshua Rosett, the process being a new one which he himself has devised. It is impossible to display fleshy fungi satisfactorily either by means of dried specimens or those preserved in liquid. There are many different types of models each of which has its own special advantage. This is the first attempt of our museum to install models of living plants and it is hoped that this collection may be added to and improved upon until we have a fairly complete display of these evanescent forms of plant life, commonly known as the fungi.

ERWIN F. SMITH—FRIEND OF YOUTH

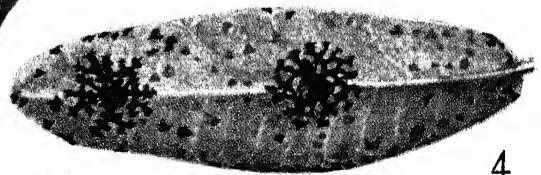
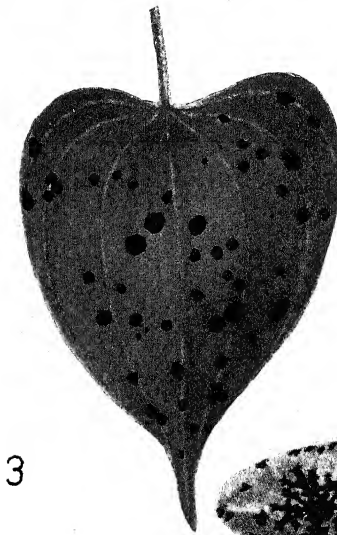
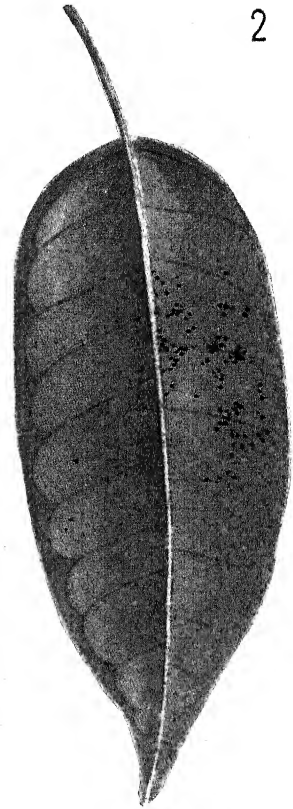
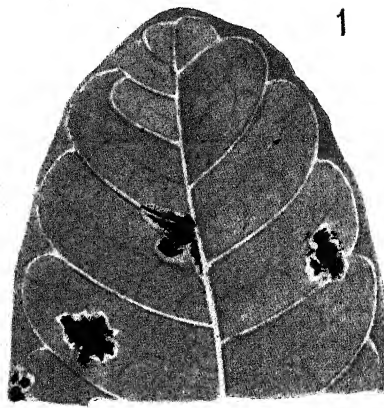
It seems desirable to relate briefly an incident concerning Dr. Erwin F. Smith, who recently passed away. In 1916, shortly after the publication of my first paper (dealing with an insect gall), I happened to meet him for the first time. He spent considerable time showing me some of his crown gall slides, telling me about his work, and discussing my "maiden effort." Picture to yourself the impression made on an unknown youngster receiving such attention from an internationally famous scientist. Having become interested in a scheme I had to produce galls artificially, he set aside a part of his already overcrowded laboratory for my use and installed a sink with water connections.

This he did, although I was employed in an entirely different government bureau having no connection with the United States Department of Agriculture. (A record of this work will be found in the *Zeitschrift für Pflanzenkrankheiten*, v. 34, pp. 344-346, 1924.)

It is a pleasure to record this episode, because I have heard it said that Dr. Smith was self-centered. May the science of Plant Pathology become richer and richer in such self-centered individuals. H. R. ROSEN.

As this issue goes to press, we have received notice of the death of Professor Bruce Fink, who was found dead in his laboratory on the morning of July 10. America thus loses one of her best known lichenologists. Dr. Fink at the time of his death was professor of botany in Miami University, Oxford, Ohio. He has been an associate editor of *MYCOLOGIA* from its beginning. A more extended article on his life and work will doubtless appear in a later issue.

News has also just been received of the death of Dr. Lars Romell of Stockholm, Sweden, on the night of July 12. Dr. Romell is well known to mycologists the world over and has served as an associate editor of *MYCOLOGIA* from its beginning. A more detailed account will appear in a later issue.



PHYLLACHORACEAE

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NEW OR INTERESTING TROPICAL AMERICAN DOTHIDEALES—I.

CARLOS E. CHARDON

(WITH PLATE 27 AND ONE TEXT FIGURE)

The tropical American species of Dothideales treated in Theissen and Sydow (1) are mostly confined to continental South America; the West Indian species were little known at the time of the publication of that monograph. Recent mycological work in Porto Rico as compiled by Seaver and Chardon (2) shows that 32 out of 73 species have been described as new by different workers. This shows that a large percentage are strictly Porto Rican or, at least, West Indian, when compared with the forms which are known to occur on the mainland. A large amount of territory, chiefly Cuba, Santo Domingo and most of the Lesser Antilles, remains to be covered. The known Cuban collections are meager, and have been accidentally picked up by botanists interested in higher plants; Santo Domingo was visited a year ago, by Dr. F. D. Kern and Mr. Rafael A. Toro, and a number of Dothideales, mostly belonging to the genus *Phyllachora*, have been lately reported by Toro (3). As to the rest of the West Indies, little or nothing is known about them. Thus there seems to be a vast field of investigation for systematic mycologists in all these islands. Mexico, Central America and northern South America are very little known also, as regards this special group of fungi.

The present paper describes a number of new or interesting

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forms. It has been based on collections examined at the New York Botanical Garden, on the Kern and Toro collections of Santo Domingo and on the writer's collections from Porto Rico. The colored plate accompanying the paper has been drawn by Mario Brau, of the Museum of the Department of Agriculture of Porto Rico.

DOTHIDEACEAE

Dothichloe nigricans (Speg.) comb. nov.

Epichloe nigricans Speg. Anal. Soc. Ci. Argent. 19: 47. 1885.

Not *Dothichloe nigricans* (Speg.) Seaver in Stevenson, Jour. Dept. Agr. Porto Rico 2: 151. 1918.

Specimens collected in Porto Rico by Whetzel and Olive on *Ichmanthus pallens* Munro and erroneously reported by Stevenson as *Dothichloe nigricans* (Speg.) Seaver were described as *Dothichloe subnodosa* sp. nov. by the writer (Mycologia 13: 287). It was found to differ widely from *Epichloe nigricans* Speg., type material of which was made available by the late Dr. Carlos Spegazzini.

Two other specimens from tropical America have been lately examined by the writer both of which compare favorably with the type of *Epichloe nigricans* Speg. Their stromata are 3-6 mm. long, and completely encircle the host, hence a new combination under *Dothichloe* is proposed here. In *Dothichloe subnodosa* Chardon, the stromata are small, 1-3 mm. in diameter and rarely encircle the host.

On *Panicum polygonatum* Schrad.

BRITISH GUIANA: A. S. Hitchcock No. 16691, Georgetown, Nov. 6, 1899.

On *Panicum* sp.

CUBA: Collected by N. L. Britton and P. Wilson, no number, deposited in part in Chardon's herbarium No. 1535, Prov. de Santa Clara, Sept. 4, 1903.

PHYLLACHORACEAE

Trabutia conspicua sp. nov.

Spots very irregular, fully occupied by the stromata; stromata black, shiny, slightly raised over the surface of the leaf, at first small, 2-5 mm. in diameter, angular, later coalescing into large,

conspicuous, tar-like spots, exceedingly irregular, sometimes star-shaped, 1-2 cm. in diameter, stromata between the cuticle and the epidermis (?); locules several in a stroma; 200-300 μ long, 150-180 μ wide; asci cylindrical-clavate, 8-spored, 110-120 \times 15-20 μ ; spores uniseriate above, biseriate in the main body of the ascus, elliptical, hyaline, continuous, 20-22 \times 6-7 μ ; paraphyses present (PLATE 27, FIG. 4).

This species is referred with some hesitancy to *Trabutia*, since the position of the stroma in the leaf was not clearly ascertained. It is a very conspicuous species on account of the large irregular or rather labyrinthiform, black stromata.

On *Capparis Grisebachii* Eichl.

CUBA: Exploration of Cuba (Britton, Earle and Wilson) No. 5959, Rio San Juan, Prov. Santa Clara, Mar. 24-25, 1910 (*type*).

***Catacauma portoricensis* sp. nov.**

Spots large, yellowish, equally visible from both sides of the leaf, 1-3 cm. in diameter, possessing many stromata; stromata black, not shining, angular, 2-4 mm. across, following the veins of the leaf and often confluent, more pronounced on the under surface, distinctly situated between the epidermis and the mesophyll; locules several, 2-4 in each stroma, angular through lateral pressure, 300-400 \times 200-250 μ ; asci cylindrical, 100-120 \times 9-12 μ , 8-spored; spores navicular, uniseriate or partially biseriate, pointed toward one end, obtuse toward the other, continuous, hyaline, possessing a large drop of oil, 21-23 \times 6-7 μ ; paraphyses present.

On *Ficus Stahlia* Warb.

Cross sections of the stromata of this interesting species show plainly the position of the stroma in the tissues of the host. The row of epidermal cells is seen distinctly above the black stromata, indicating that the stroma is located between the epidermis and the mesophyll of the leaf. This stromatic character makes the fungus fall under the Scirrhiineae of the Phyllachoraceae, in the treatment of Theissen and Sydow. In the fresh material a whitish, gelatinous substance was oozing out of the individual stromata on the under surface of the leaves. A microscopical examination of this substance showed it to consist of an immensely large number of spores which are being liberated. This occurred right after a rain. This rather unique method of spore liberation in one of the Dothideales has never before been seen by the writer.

PORTO RICO: Chardon No. 1543, Quebradillas, Mar. 17, 1922 (*type*); Chardon No. 1608, Sabana Hoyos, Aug. 26, 1922.

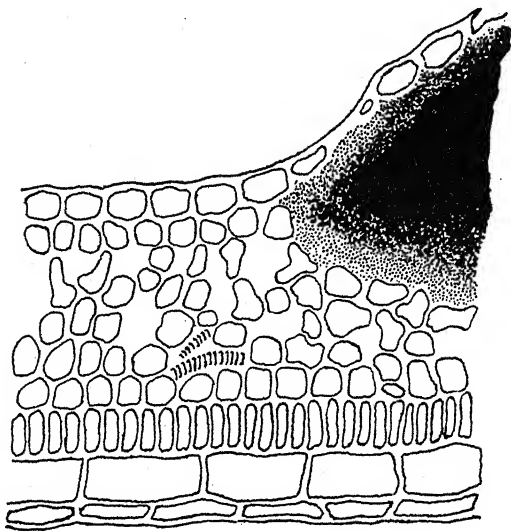


FIG. 1. *Catacauma portoricensis*. Cross section of stroma

***Catacauma Brittoniana* sp. nov.**

Spots large, yellowish, 10 to 15 mm. in diameter, very conspicuous on the under surface of the leaf, scarcely so on the upper surface, possessing many confluent stromata; stromata black, not shiny, 2-5 mm. across or even more through the coalescence of various stromata, largely raised and very pronounced on the under surface, sometimes but not always following the veins of the leaf, distinctly situated between the epidermis and the mesophyll; locules several, 2-7 in each stroma, flattened, or angular through lateral pressure, $300-360 \times 150-200 \mu$; asci cylindrical-clavate, $66-82 \times 10-12 \mu$, 8-spored; spores navicular, uniseriate above, biseriate in the main body of the ascus, continuous, hyaline, $15-18 \times 4-5 \mu$, possessing one or several oil drops; paraphyses present, profuse (PLATE 27, FIG. 1).

On *Ficus subscabrida* Warb.

A cross section of the stroma of this species, like the previous one, showed it to be distinctly between the epidermis and the mesophyll. In sections of very young stromata, the epidermal cells of the leaf of the host showed clearly above the stromatal tissue. The species thus appears to be a true *Catacauma*, unlike any other species described.

ISLE OF PINES: Explorations of Cuba No. 15472 (Britton, Britton & Wilson), San Juan, Mar. 15-17, 1916 (*type*).

***Phyllachora Kerniana* sp. nov.**

Stromata amphigenous, black, shining circular, 1 mm. or less in diameter on the upper surface, not shining but more prominent (papillate) on the under surface, seldom coalescing, uniloculate; locules subglobose, fairly regular, distinctly immersed in the mesophyll, 185-250 μ long, 120-150 μ wide; asci cylindrical-clavate, 72-90 \times 12-16 μ , 8-spored; spores uniseriate above, biseriate in the main body of the ascus, ellipsoidal, 14-17 \times 6-7 μ , hyaline, continuous; paraphyses present (PLATE 27, FIG. 2).

On *Catalpa longissima* Jacq.

The small punctiform stromata protruding in the under surface of the leaf is very characteristic of this species.

SANTO DOMINGO: Kern & Toro No. 225, La Vega, Mar. 17, 1926 (*type*).

***Phyllachora inconspicua* sp. nov.**

Stromata amphigenous, black, shining, 1 mm. in diameter on the upper surface, rarely confluent, also small, inconspicuous and brown on the under surface, uniloculate; locules subglobose or irregular, distinctly immersed in the mesophyll, 180-300 μ long, 100-150 μ wide; asci elliptical-clavate, 70-95 \times 12-18 μ , 8-spored; spores uniseriate above, biseriate in the main body of the ascus, ellipsoidal, 13-15 \times 7-8 μ , hyaline, continuous; paraphyses present.

On *Stigmaphyllon lingulatum* (Poir.) Small.

The material examined is full of the rust *Puccinia inflata* Arth., whose purple shiny sori must not be confused with the stromata of this new *Phyllachora*. A very rare species only known from a single collection.

PORTO RICO: Cornell University Explorations of Porto Rico (C. E. Chardon) No. 901, Peñuelas, July 30, 1920 (*type*).

***Phyllachora domingensis* sp. nov.**

Stromata amphigenous, black, not shiny, very conspicuous, 1-2.5 mm. in diameter, more or less circular, equally visible from both surfaces of the leaf, plurilocular; locules globose, flattened, distinctly immersed in the mesophyll, 220-380 μ long, 160-220 μ wide; asci cylindrical or cylindrical-clavate, 85-110 \times 11-15 μ , 8-spored; spores uniseriate, or partially biseriate, long elliptical,

somewhat pointed at the end, $18-22 \times 5-6 \mu$, hyaline, continuous; paraphyses present.

On *Picramnia pentandra* Sw.

This species is distinctly new, and evidently different from other Phyllachoraceae on *Picramnia* in Theissen and Sydow which fall under different genera, as *Endodothella* and *Telimena*.

SANTO DOMINGO: Kern & Toro No. 187, San Cristóbal, Mar. 14, 1926; Kern & Toro No. 268, Santiago, Mar. 21, 1926 (*type*).

Phyllachora Eugeniae sp. nov.

Spots amphigenous, appearing as discolored circular areas, later fully occupied by the stromata; stromata black, shiny, 1 to 2.5 mm. in diameter, roughly circular on the under surface, not shiny, smaller and less conspicuous on the upper surface, plurilocular, fully occupying the mesophyll; locules globose or subglobose, $110-150 \mu$ long, $80-130 \mu$ wide; asci cylindrical, 8-spored, $60-75 \times 7-9 \mu$; spores obliquely uniseriate, or biseriate in the main body of the ascus, ellipsoidal, hyaline, continuous, $8-10 \times 4-4.5 \mu$; paraphyses present.

On *Eugenia rhombea* (Berg.) Krug & Urban.

This species is distinct from others reported on *Eugenia*. *Phyllachora biareolata* Speg. is known from Brazil, Argentine and Paraguay, but the type species which has been examined shows a very characteristic and regular zone of dead tissue around the stromata bordered by a conspicuous black margin which is not present in our specimen. Seaver (4) reported the occurrence of *P. biareolata* Speg. on *Eugenia rhombea* in Saint Croix "although no authentic material had been seen." Certainly, our Porto Rican material is not that species. It also differs widely, in both stromatal and spore characters, from *Phyllachora Wietzelii* Chardon, also on *Eugenia* from Porto Rico and Santo Domingo.

PORTO RICO: University of Illinois, Porto Rican Fungi (F. L. Stevens) No. 321, Guánica, Feb. 3, 1913 (*type*).

PHYLLACHORA ULEI Winter, Grevillea 15: 90.

On *Rajania cordata* L. and *Dioscorea* spp.

This conspicuous and beautiful species seems to be common in Porto Rico, but appears to be heretofore unreported from the island. The stromata are shining black, 2-5 mm. in diameter and more or less rounded. The spores in Winter's species are

18–20 \times 5–6 μ ; in the material examined they appear to be smaller, 12–13 \times 5–6 μ , but this difference is scarcely sufficient to warrant the erection of a new species. Perhaps it might be considered as a variety of *P. Ulei* which is only known to occur in the continent of South America (PLATE 27, FIG. 3).

PORTO RICO: Fink No. 459, Rio Piedras, Nov. 30, 1915; Stevenson No. 3459, Rio Piedras, Dec. 12, 1915; Stevenson & Rose No. 5797, Rio Piedras, Nov. 17, 1916; Chardon No. 1539, Las Cruces, Mar. 29, 1922.

PHYLLACHORA WHETZELII Chardon, Mycologia 13: 293. 1921.

On *Eugenia monticola* Sw.

This appears to be the first report of this species outside of Porto Rico, where it was supposed to be endemic. The material seems to be identical with the *type*.

SANTO DOMINGO: Kern & Toro No. 188, San Cristóbal, March 14, 1926.

RIO PIEDRAS, PORTO RICO

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EXPLANATION OF PLATE 27

Fig. 1. Under surface of leaf of *Ficus subscabrida* showing stromata of *Catacauma Brittoniana* (4/5 nat. size).

Fig. 2. Under surface of leaf of *Catalpa longissima* showing minute stromata of *Phyllachora Kerniana* (4/5 nat. size).

Fig. 3. Under surface of leaf of *Dioscorea* sp. showing tar-spot stromata of *Phyllachora Ulei* Winter (4/5 nat. size).

Fig. 4. Upper surface of leaf of *Capparis Grisebachii* showing labyrinthiform stromata of *Trabutia conspicua* (4/5 nat. size).

HETEROTHALLISM IN BLAKESLEA TRISPORA

GEORGE F. WEBER AND FREDERICK A. WOLF¹

(WITH PLATES, 28-30)

During the summer of 1925 the phycomycetous fungus, *Blakeslea trispora* Thaxter, appeared at Gainesville, Florida, as a contaminant in planted plate cultures of fungous sclerotia made by the senior writer (1).² It was soon afterward isolated from the surface of lesions on cucumber leaves. Several plantings of sporangiospores were made at that time on potato agar plates and it was noted after 24 hours that a line of zygospores bordered one of the colonies resultant from these plantings. Since this organism had hitherto been known only in its sporangial stage, a study was begun to determine the conditions necessary for the formation of zygospores. These studies have shown that this phenomenon is dependent upon the presence of two strains which according to terminology employed with other dioecious fungi are designated as the plus (+) strain and the minus (-) strain respectively. They are usually distinguishable in pure culture by the number and size of the sporangia, the more fruitful one being plus and the less fruitful, minus. Dr. A. F. Blakeslee after studying these strains verified this observation and conclusion. The fruitfulness, however, is not a dependable criterion since under certain conditions sporangia are not produced in either strain.

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Frederick A. Wolf, Pathologist, Office of Fruit Diseases, Bureau of Plant Industry, United States Department of Agriculture, Orlando, Florida.

The experimental work of each writer has been done entirely independently. Since that of the senior writer was practically complete before the studies of the junior were begun, and since the results of both are in entire accord, it is deemed best to prepare this report conjointly.

² Reported by Weber, George F. Plus (+) and Minus (-) Strains of *Blakeslea trispora* Thaxter, Abst. Bot. Soc. Am. Kansas City, Dec. 1925. (Unpublished.)

The junior writer first noted this peculiar fungus during the summer of 1926 in the vicinity of Orlando, Florida. It was found to be of common occurrence on *Sida acuta*, a malvaceous weed which is of wide distribution in orange groves throughout the state. It appears on the fading flowers but is most conspicuous in late summer after the weeds have been mowed when it covers the withered leaves and stems profusely.

The metallic luster of the sporangiophore stalks presents the appearance, at first glance, of the closely related *Choaneophora Cucurbitarum* (Berk. & Rav.) Thaxter, which may be growing interspersed with it on the same substratum. In fact it was at first thought by the junior writer to be a *Choaneophora* whose fruiting branches were approximately half as tall as those of the well-known *C. Cucurbitarum*. Because of the dichotomous branching of the fruiting stalks it was tentatively identified as *C. dichotoma*.

An examination of available literature revealed the curious coincidence that this binomial had previously been employed by Gandrup (4 & 5) for a species which in Sumatra is associated with a mustiness of freshly picked tobacco leaves. It was furthermore found through correspondence with the Director of the Experimental Station at Deli, Medan, that no technical description of *C. dichotoma* was ever prepared since the fungus was found, on subsequent study by Gandrup and his associates (4 & 7), to be identical with *Blakeslea trispora*.

It appears that no studies of this fungus have been made except by Thaxter in 1914 (6). The original strain of this fungus from which Thaxter made his description appeared as a contamination in plated cultures of *Botrytis Rileyii* from the velvet bean caterpillar (*Anticarsia gemmatilis* Hbn.) made by Dr. O. F. Burger, in 1912, at Gainesville, Florida. This culture was sent to Dr. Thaxter who two years later published (6) the description of the genus and species. Further, the only record of its occurrence outside of Florida appears to be from the reports of Gandrup (4, 5, 7). Special consideration will be given in the present report to the morphology and development of the zygosporic stage. The brief recapitulation herein given of the morphology of the sporangial stage confirms entirely the researches of Thaxter.

Blakeslea trispora grows readily on agar media. Cultures 24 to 48 hours old bear at the same time sporangia of several types, together with chlamydospores and zygosporos, and the plant is therefore to be regarded as especially favorable for study. The mycelium in culture forms a dense cottony mass that usually shows shades of orange or yellow at the surface of the medium. This is particularly true when the fungus is growing on 2 per cent potato dextrose agar. When growing on 5 per cent agar the orange coloring is much more intensified and in this case few or no sporangia are developed. In development the sporangia are distinctly heliotropic and will change in a few hours when the culture is turned 180° from the source of light. The production of sporangia is influenced very little by light since they grow profusely in bright or subdued light and in total darkness. The intensity of the light, however, modifies the length of the sporangiophore, the shortest being produced in bright light. When sporangiophores are formed in culture, there is no evidence of a metallic luster such as occurs in its natural habitat. The fertile hyphae of most common occurrence are dendroid, dichotomously branched structures whose branches and branchlets are nodose in outline and bear at the tips globular sporangioliferous heads (PLATE 30, FIGS. 1 AND 2). The number of these ultimate heads varies from two to thirty-two, with a corresponding variation in size of the supporting stalk. From thirty to forty broadly elliptic sporangiola are borne on the surface of each sporangioliferous head. These sporangiola are attached by short stout stalks which, when the sporangiolum is removed, may remain attached to the head (PLATE 30, FIG. 3). If instead it adheres to the sporangiolum, it assumes the form of an elliptical vesicle (PLATE 30, FIG. 8). Each sporangiolum contains typically three elongate, elliptical spores whose long axis is parallel to the long axis of the sporangiolum. The spores while within the sporangiola are compressed along the opposed faces but become rounded out on being set free. They are purplish brown in color and their surface is marked by longitudinal striations with ramifications extending between striae. A tuft of very fine appendages, approximating the length of the spores, arises at either pole (PLATE 30, FIGS. 4 AND 5). The sizes of the spores average $12 \times 6 \mu$, with a range of 8 to 18 by 5 to 8 μ .

In addition to the sporangia which have just been described, others of the type characteristic of the genus *Choanephora* have always appeared in cultures and are common in the stems of *Sida*. These sporangia are extremely variable in size and in the size and number of spores which they contain. In culture they usually appear a day or two after the larger forms already described. The larger (PLATE 30, FIG. 7) average 50 to 75 μ in diameter and possess a columella. This structure is absent in the smaller whose diameter may be 14 to 16 μ (PLATE 30, FIG. 6). As Thaxter has pointed out, every imaginable intermediate condition between a form represented in Plate 30, Figure 7, and a three-spored sporangium may be met with, so that no clear-cut distinction between the two types of sporangia remains. These sporangia of this second type are nodding or circinate and only rarely erect. The columella of the larger sporangia is broadly elliptical. The sporangial wall of the smaller is incrustated with angular spicules. The six to eight spores borne in the smaller ones may be twice as large as those in the large sporangia. All are alike, however, in the possession of a finely corrugated wall and polar appendages. All germinate readily within a few hours by the production of lateral or terminal germ tubes (PLATE 30, FIG. 5).

Chlamydospores are formed especially in old cultures. They are globular to ovoid in shape (PLATE 30, FIG. 12).

Two methods have been employed in isolating the two strains. When sporangiospores "en masse" from the two sides of the line of zygosporangia were planted on another plate, a line of zygosporangia was formed again at the juncture of the two resultant colonies. The colonies from both strains are alike in appearance except that the one which has been designated plus usually forms sporangia more abundantly. Further, neither strain when planted alone will produce zygosporangia (PLATE 28). When, however, both strains are planted together, as has been done months after their isolation, they behave just as was the case when they were first isolated (PLATE 29).

The two strains have been isolated also from single spores by repeated dilution of a suspension of spores and planting in poured plates. As soon as growth had begun, as determined by microscopic examination through the bottom of the Petri dish cultures,

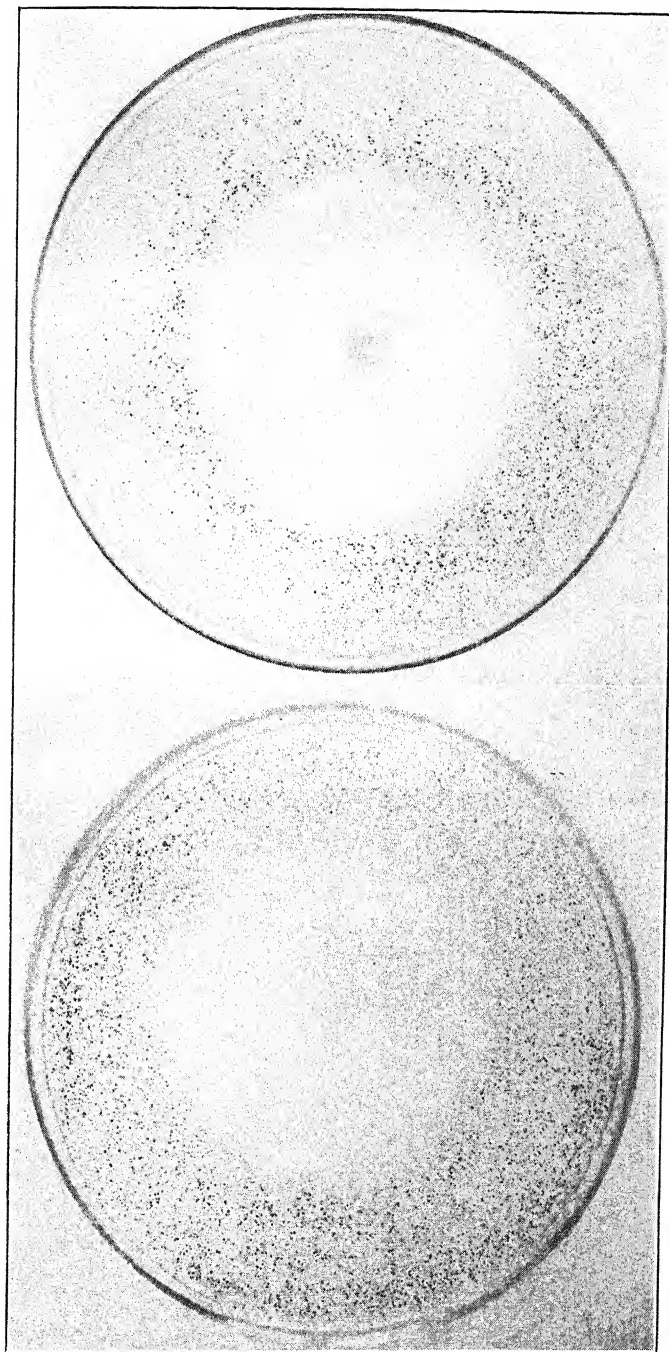
the spores were cut out with a block of surrounding agar. Of thirteen isolations made in this manner two proved on subsequent trial to be of one strain and eleven of the other.

The process of zygospore formation is essentially like that which has been described for *Choanephora* as illustrated by *C. infundibulifera* (3), *C. Cucurbitarum* (8), and *C. conjuncta* (2). The hyphae of the two strains are first noted to be more or less closely entwined. The tips of these hyphae next become enlarged and densely filled with granular protoplasm after which a septum is formed which delimits each progamete. Each progamete then divides into two which results in the separation of the gamete and suspensor (PLATE 30, FIG. 10). The wall between adjacent gametes becomes flattened on the opposed faces, that portion in contact is absorbed, and the two gametes fuse. Then as the young zygote increases in size the two saccular suspensors become clear and are devoid of protoplasmic content (PLATE 30, FIG. 9). As the zygospore approaches maturity the numerous oil globules within it fuse to make one large central globule. Meanwhile the exospore has thickened and become dark brown in color. At maturity the zygospore is supported from the lower side by the two suspensors and is either globular in outline or slightly flattened on the lower side. The zygospores measure 38 to 61 by 45 to 63 μ (PLATE 30, FIG. 11).

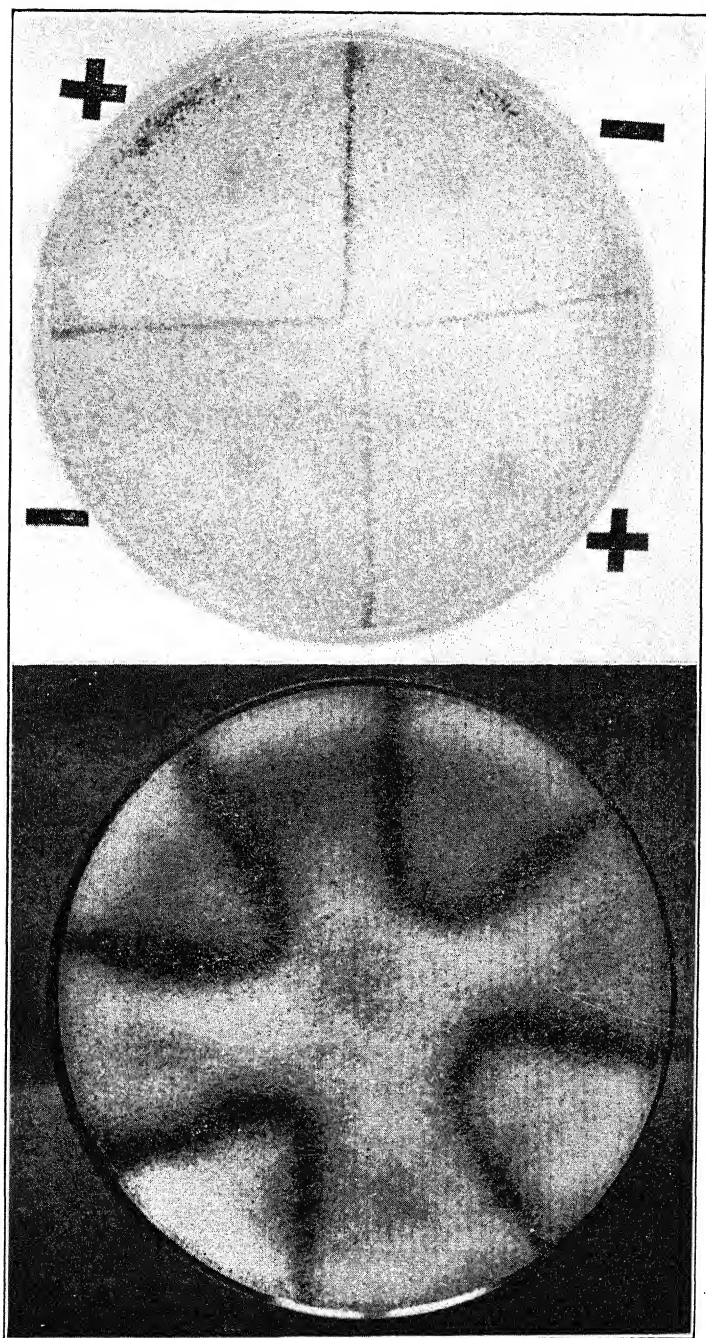
The fact that the zygospores of *Blakeslea* and *Choanephora* are so similar adds to the proof of their close relationship as indicated by Thaxter (6). Furthermore, as he points out, the close correspondence of the sporangiola of the former with the conidia of the latter, in form, color, striation and origin from vesicular heads, shows that they are homologous and that the conidia of *Choanephora* may appropriately be regarded as monosporous sporangia.

SUMMARY

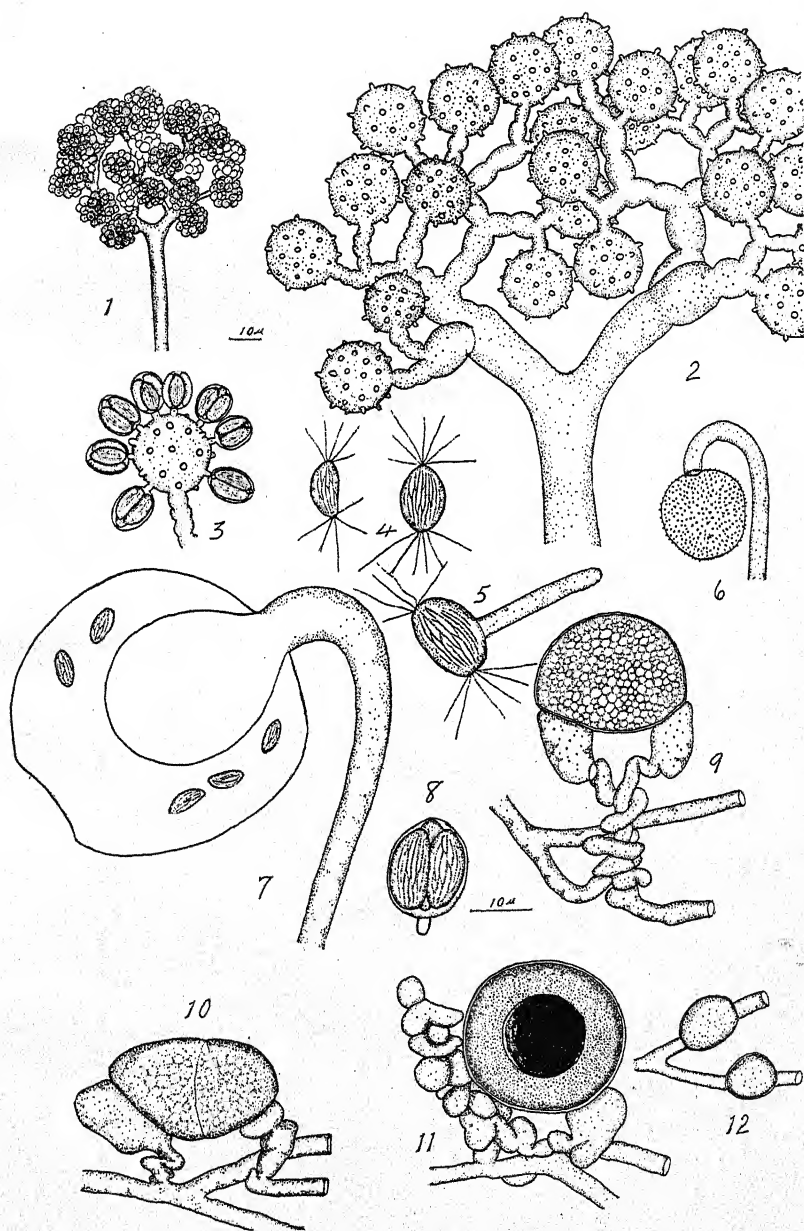
Blakeslea trispora Thaxter, which has hitherto been known only in the sporangial stage, has been found to produce zygospores. Zygospore production is dependent upon the presence of the plus (+) and minus (-) strains. The only apparent difference in the two strains is the ability of the one to produce sporangia in greater abundance.



BLAKESLEA TRISPORA



BLAKESLEA TRISPORA



BLAKESLEA TRISPORA

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EXPLANATION OF PLATES

PLATE 28

Blakeslea trispora in culture. Upper, plus strain, lower, minus strain, showing more profuse development of sporangia by the former.

PLATE 29

Lines of zygosporic production. Adjacent quadrants of opposite sex in upper figure. Alternate plantings of opposite sex in lower figure resulted in formation of maltese cross by lines of zygospores.

PLATE 30

Figs. 2, 3, 6, 7, 9, 10, 11 and 12 drawn to scale above Fig. 3. Figs. 4, 5 and 8 to scale near Fig. 8.

Fig. 1. Habit sketch of fruiting branch of *Blakeslea trispora*; Fig. 2. Dichotomously branched sporangiophore with sporangioliferous heads from which the sporangioles have been removed; Fig. 3. Sporangioliferous head with a portion of sporangioles in situ; Fig. 4. Sporangiospores; Fig. 5. Sprouting sporangiospore; Fig. 6. Small nodding sporangium of the kind which lacks a columella; Fig. 7. Large nodding sporangium with columella; Fig. 8. Sporangiolium with hyaline vesicular stalk; Fig. 9. Zygosporic filled with oil droplets supported by suspensors and coiled hyphae; Fig. 10. Gametes in stage just prior to dissolution of walls and fusion of gametes; Fig. 11. Mature zygosporic with large oil drop and thick exospore; Fig. 12. Chlamydospores.

NEW OR OTHERWISE INTERESTING AGARICACEAE FROM THE UNITED STATES AND CANADA ¹

LOUIS C. C. KRIEGER

(WITH PLATES 31-36)

Agaricus auricolor n. sp. (PL. 36, FIG. 2.)

Pileus campanulate, not over 4 cm. broad, bright cadmium yellow on the disk, the rest of the surface white or whitish and adorned with cadmium-colored squamules; margin thin, split, bearing traces of the white veil. Gills narrow, smoky chocolate colored inclining toward brown, connected near the stem which they approach closely but to which they are not attached. Stem about 4.5 cm. long, 7.5 mm. thick above, tapering downward almost to a point, white and smooth above the ring, below it loosely white-squamulose, stained yellow at the base, hollow-stuffed within; flesh turning yellow. Ring markedly developed, thin but somewhat persistent, flaring, the edge dentate with small adhering yellowish protuberances. Spores $5.5 \times 3.3 \mu$ (usual size).

Found by Dr. Frederick J. Wilkens, near State Sanatorium, Md., July 26, 1922. No. 1521.

At first I was inclined to regard this plant as a species of *Stropharia*, but the free gills forbade such a reference. The specimen was perfectly fresh when it was placed in my hands. The pointed stem is a remarkable feature. It resembles *Stropharia obturata* Fries.

Amanita brunnescens var. *pallida* n. var.

Some specimens, even young ones, are very pale (even white), with the other characters the same as in the typical form. Found near Magnetawan, Ontario, Canada, July 22, 1921. Nos. 941, 1613 and 1870.

Amanita corticelli (Valenti-Serini) n. comb. (PL. 32, FIG. 1).

(Syn., *Volvaria corticelli* Valenti-Serini, *Amanita lepiotoides* Barla, and *Amanitopsis lepiotoides* Sacc.)

¹ The numbers refer to the specimens preserved in the herbarium of the Howard A. Kelly Mycological Library.

This species, one of the *ovoidea-coccicola-barlae* group, seems to be limited in its occurrence to mountainous regions. Some authorities are inclined to regard it as a mere meteorological sport of *A. Coccicola*.

Blue Ridge Summit, Md., near Friends Creek, August 20, 1923. Nos. 1415 and 1545.

***Amanita crassivolvata* n. sp. (PL. 32, FIG. 2.)**

Pileus 8 cm. broad, convex to explanate, very dark brown all over, almost black, especially in the center, virgate, glabrous except for a few small flat darkish volva-patches; margin even, not striate. Gills white, with a pale creamy tinge, close, unequal, 8 mm. broad, slightly narrower toward the stem, and there almost adnately attached. Stem 12 cm. where it enters the pileus, white to pale creamy white, perfectly smooth, the base rounded off and attached to the center of the curiously cup-like white volva. The free limb of the latter thick (about 6 mm.), 1.5 cm. long, and somewhat lobed. Ring yellowish white, moderately large, deflexed, median. Spores hyaline, subglobose, $8.8 \times 7.7 \mu$.

Found at Stow, Mass., October, 1911. Collector, Mr. Simon Davis. No. 841.

***Amanita porphyria* var. *lavendula* (Coker) n. comb.**

Syn., *Amanita mappa* var. *lavendula* Coker.

Coker's plant is doubtless a variety of *A. porphyria* rather than of *A. mappa*.

***Armillaria cingulata* Fries.**

Magnetawan, Ontario, Canada, September, 1921. Collector Prof. H. C. Beardslee. No. 1366.

Apparently unreported from North America.

***Collybia maculata* (Alb. & Schw.) Fries, abortive form. (PL. 31.)**

A malformed specimen in which the gills failed to develop. This species is given to the production of monstrous forms, as was shown by Boudier, who described and figured a curious cyclomycetoid specimen. (Bull. Soc. Bot. Fr. 19:141. 1872.)

Stow, Mass., September 18, 1909. Collector, Mr. Simon Davis.

***Cortinarius rubroclavus* n. sp. (PL. 35.)**

Pileus 6 cm. broad, expanded, rounded-umbonate, pale yellow with a tinge of dull red, faintly fibrillose-squamulose; margin

decurved. Gills subdistant, pale lemon-yellow at first (no trace of either violet or purple), then inclining to cinnamon; edges eroded. Stem 10 cm. long, 1.5 cm. thick, equal until the conspicuous bulb (3.5 cm. thick) is reached, white but changing rapidly to a deep saffron red (from handling), especially the bulb, solid within and creamy white, with stains of saffron red. Cortina high up on the stem, fibrillose, ferruginous-cinnamon from the spores. Spores $7 \times 5 \mu$, bright yellow-cinnamon under the microscope, rough-granular within.

Anne Arundel Co., Md., near the Severn River, October 3, 1919. No. 256.

Peck's *C. albidipes*, though it resembles the present species, has a permanently white stem, and gills that are violaceous when young. *C. Bulliardii* (Pers.) Fries, *C. rubripes* Kauff., and *C. colus* Fries are also different.

Hebeloma hortense Burt.

Grown on a lawn from spawn kindly supplied by Prof. Burt. Several plants came up on the very spot where the spawn had been planted. (No. 922.) The caps were very finely lacunose under a hand-lens, isabelline colored, darker on the margin (hygrophanous?). Stem striate above. Mycelium and adhering earth forming a ball at the base of the stem. Odor exactly like that of *Naucoria semiorbicularis* (Bull.) Fries, i.e., powerfully farinaceous, or cucumber-like.

The plants suggested strong kinship, if not identity, with *Naucoria sororia* Peck, a robust "sister" of *N. semiorbicularis*.

***Hygrophorus proximus* n. sp.** (Pl. 34, Fig. 3.)

Pileus 5.5 cm. broad, slightly repand, pinkish-creamy, and with a fine purplish-red scattered tomentum that forms darker spots of purple-red on the moderately elevated disk; flesh very thin toward the margin. Gills *very narrow and close*, unequal, creamy white, markedly decurrent. Stem 5 cm. long, 1.2 cm. thick, tapering a little below, white, with a pinkish-lavender tinge, slightly fibrillose with a few purplish fibrils, punctate above with pale tomentose dots. Flesh of stem and pileus solid and white, or very faintly pinkish. While drying, the plant emitted an odor of rancid lard. Spores hyaline, $6.6 \times 4.4 \mu$.

Collected at Belair, Md., October 7, 1919, by Miss Olga E. B. Kelly. No. 287.

It seems near *H. erubescens* Fries, hence the specific name.

The gills of my plant are much closer and narrower, and the spores considerably smaller than in the Friesian species.

Lactarius Allardii Coker.

Collected in Gwynn's Falls Park, Baltimore, Md., August 14, 1919, on mossy ground in beech woods. No. 84.

These plants agreed well with Coker's description, except that the surface of the pileus was a little rugulose in places, and wounds eventually became olive-brown. A fine pinkish bloom was present on the margin of the pileus. The gills were interconnected, and venose at the point of their attachment to the pileus. Stems inclined to whitish on one side. Spots on stem (produced by handling) turned olive-brown. The pink of the flesh took some time to develop, but, once it had started to appear, it soon deepened to a richer shade, finally ending in a dull pink. The somewhat sparse milk turned to a faintly pink tint at first, then to a dirty olive-brown. One specimen, the smaller one, had the margin of the pileus grown fast to the stem.

Mycena inconspicua n. sp.; in the nomenclature of the North American Flora, *PRUNULUS INCONSPICUUS*. (PL. 36, FIG. 1.)

Pileus up to 7 mm. broad when fully expanded, broadly campanulate, with a rounded disk, brownish-ochraceous, becoming paler with age toward the margin (there almost white); latter straight from the first, striate, the striations conspicuous and reaching almost to the disk; flesh so thin as to appear membranous. Gills subdistant, unequal, white, broad for their size, rounded and ascending toward the stem where they are adnexed; edges entire, concolorous. Stem delicate, about 1.5 to 1.7 cm. long, 1.5 to 2 mm. thick, usually curved, equal or slightly thicker below, white but not shining, finely pubescent under a hand-lens, cartilaginous, tubular. Spores smooth, elliptical, one end somewhat truncate, uniguttulate, slightly pinkish within, $7.7 \times 4.8 \mu$.

Baltimore, Md., July 20, 1919. Grew cespitosely on naked soil at a street corner. No. 375.

Near *M. minutissima* Murrill and *M. paupercula* Berk., but neither.

NAUCORIA CHRISTINAE (Fries) Sacc.

In a wood near Lynn, Mass., my colleague, Mr. Hollis Webster, showed me how the pilei of this highly interesting species originate

deep down in the leaf-mold, and how they then punch their way through the overlying leafy débris until the open air is reached and the spores are liberated. The sharp mucronate umbo serves admirably in the performance of this task; indeed, the pileus is little more than umbo, the rest of the flesh being just thick enough to give support to the gills underneath.

PANAEOLUS SOLIDIPIES Peck, sterile form.

In Druid Hill Park, Baltimore, Md., among hundreds of normal specimens of this species, I found a single fully grown one that was completely sterile. The gills were of a pallid isabelline color, not in the least black. No. 1645.

Pluteus leoninus var. *oculatus* n. var. (PL. 36, FIG. 3.)

Differs from the typical species in having the center of the pileus colored a very dark brown. When seen from afar, the pilei simulate Black-eyed Susans (*Rudbeckia hirta*).

Magnetawan, Ontario, Canada, July 29, 1921. No. 1197.
Pluteus salicinus (Pers.) Fries (PL. 34, FIG. 2.)

Magnetawan, Ontario, Canada, August 18, 1921. No. 1260.
On rotten wood.

As this species has never before been reported from this continent (Kauffman reports merely a very questionable variety of it), I include my notes in full.

Pileus about 6 cm. broad, expanded, with a slight umbo, dark gray from the presence of very fine fasciculate woolly fibrils, which, in parting, give the surface a radiately streaked appearance; central portion densely dotted with very dark small erect flocci, and somewhat greenish; margin not striate. Gills close, unequal, free, rather broad, narrowed posteriorly, of a bright warm pink; edges concolorous, somewhat eroded, under a hand-lens slightly fimbriate, and whitish. Stem about 6 cm. long, 8 mm. thick at the base, tapering upward to a diameter of 6 mm., white, with blue fibrils on the lower half, especially on the slightly spreading base; flesh white, solid (!). The flesh of the pileus white, except for a fuliginous tint immediately under the surface. Spores $9.3-11 \times 5.5-6 \mu$. Cystidia usually bicornate.

Kauffman's statement that the stem in this species is not solid (Agaric. of Mich., p. 535) is not borne out by my material, nor is it supported by the original diagnosis and illustrations in Persoon's *Icones et Descriptiones*.

***Stropharia aeruginosa* var. *exsquamosa* n. var. (Pl. 34, FIG. 1.)**

Pileus about 3 cm. broad, convex, viscid, the center elevated, glabrous, green, the disk with a tinge of brown; margin white, even, appendiculate with fragments of the veil; flesh white throughout the plant. Gills purplish blue, broad, sinuate-adnate, close; edges finely crenate and whitish. Stem 4 cm. long, white, utterly devoid of squamules, merely slightly striate, 7 mm. thick, somewhat enlarged where the ring is attached, stuffed, then hollow. Ring superior, slight, white. Spores $6.6-7.3 \times 4.8 \mu$.

Gunpowder River region, Baltimore Co., Md., September 27, 1919. No. 187.

In drying, the whole plant turns yellow. It is not *S. albocyanea* Desm., a much slenderer plant.

TRICHOLOMA PANAEOLUM var. CAESPITOSUM Bres.

Baltimore, Md., near New Jerusalem, September 23, 1924. No. 1866.

Found forming a huge fairy ring, 27 feet in diameter, around a spice bush (*Lindera Benzoin*). Rea says that *T. panaeolum* forms large rings in pastures (Brit. Basid., p. 238).

For the specimens, I am indebted to Prof. C. C. Plitt, the well-known lichenologist.

***Tricholoma sejunctum* var. *rubroscabrum* n. var. (Pl. 33.)**

Pileus 16 cm. broad, convex, with a broad uneven umbo, brownish yellow, the umbo dark reddish brown, virgate-rimose, toward the margin squamulose; margin persistently involute, much lobed. Gills rather broad, narrower toward the margin, pinkish creamy, close, unequal, sinuate; edges uneven. Stem 14 cm. long, 3 cm. thick above, enormously enlarged downward, about 6.5 cm. near the base, light pink, beautifully adorned throughout its length with conspicuous red scales; interior fibrous-solid. Flesh of pileus and stem pinkish, deeper in the former and there inclining to a brown pink. Spores $5.5 \times 4 \mu$.

Boston, Mass., Blue Hills Reservation, September, 1911. No. 405.

Except for the absence of the pink color and red scales of the stem, Schulz's plate of *T. sejunctum* var. *coryphaeum* (Fries) is a fairly close approximation to the present variety. (Schulz-Michael, Führer für Pilzfreunde, p. 23.) *T. Colossum* Fries, regarded by Boudier as an *Armillaria*, is related. (Bull. Soc. Myc. Fr. 16:18. 1900.)

Fries' *T. sejunctum*, being quite different from that of Sowerby, I venture to apply to it the new varietal name, *Tricholoma sejunctum* var. *Friesii*. Kauffman has already referred Peck's *T. intermedium* to Sowerby's species as a variety. We have thus four varieties of *T. sejunctum* Sowerby, viz., *Friesii*, *coryphaeum*, *intermedium*, and the present one, *rubroscabrum*.

T. Cisarnii Roum. is given as related to *T. coryphaeum*.

The plant commonly found in North America is Sowerby's type. *T. coryphaeum* has been reported but once. (Bull. 19, Boston Mycological Club. 1903.)

EXPLANATION OF PLATES

PLATE 31

Collybia maculata, abortive form.

PLATE 32

Fig. 1. *Amanita corticelli*; Fig. 2. *Amanita crassivolvata*; Fig. 2a, section.

PLATE 33

Tricholoma sejunctum var. *rubroscabrum*.

PLATE 34

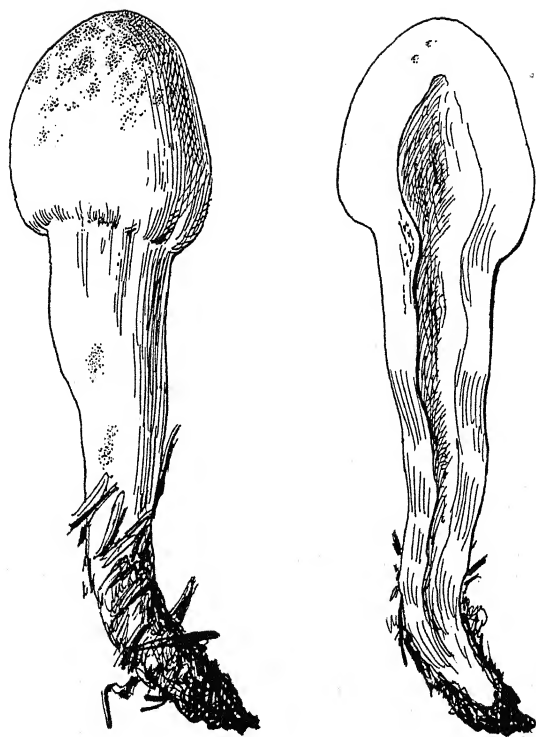
Fig. 1. *Stropharia aeruginosa* var. *exsquamosa*; Fig. 2. *Pluteus salicinus*; Fig. 2a, top view of the pileus; Fig. 2b, section; Fig. 3. *Hygrophorus proximus*.

PLATE 35

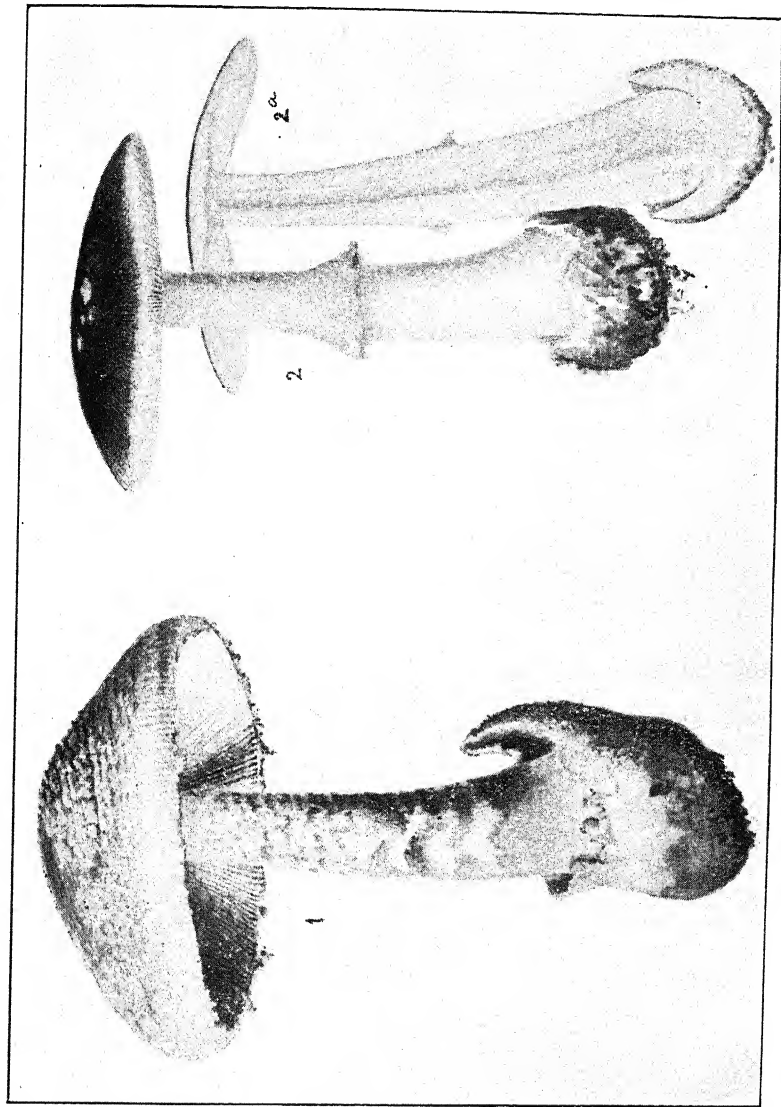
Cortinarius rubroclavus.

PLATE 36

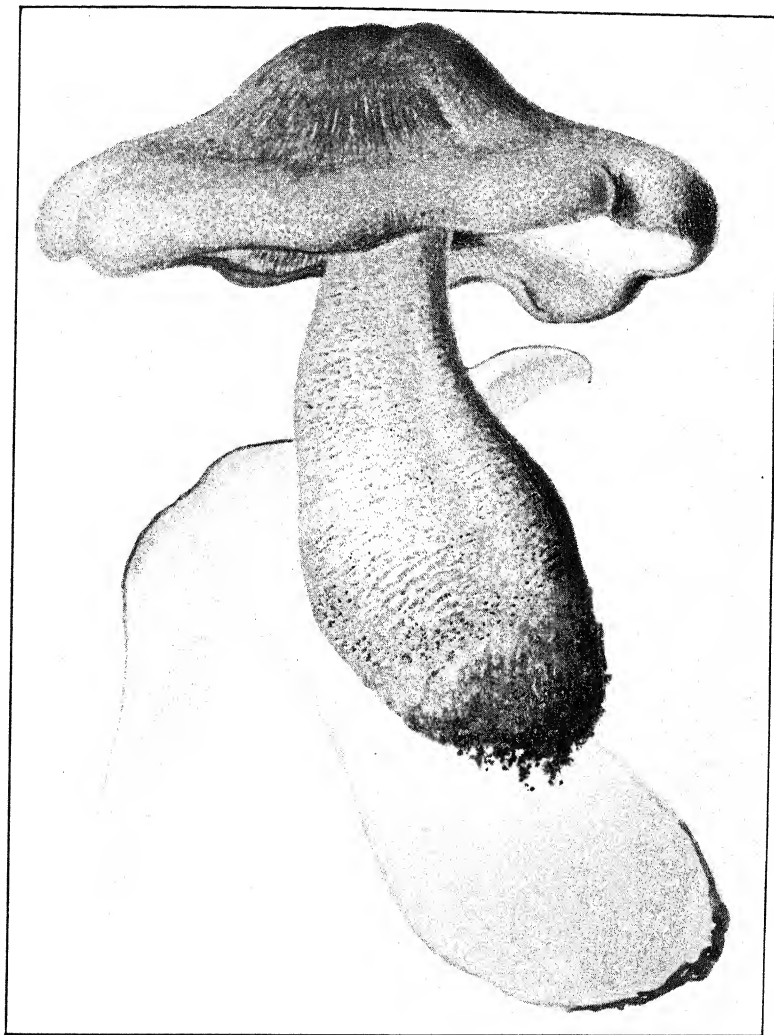
Fig. 1. *Mycena inconspicua*; Fig. 1a, section; Fig. 2. *Agaricus auricolor*; Fig. 3. *Pluteus leoninus* var. *oculatus*; Fig. 3a, section.



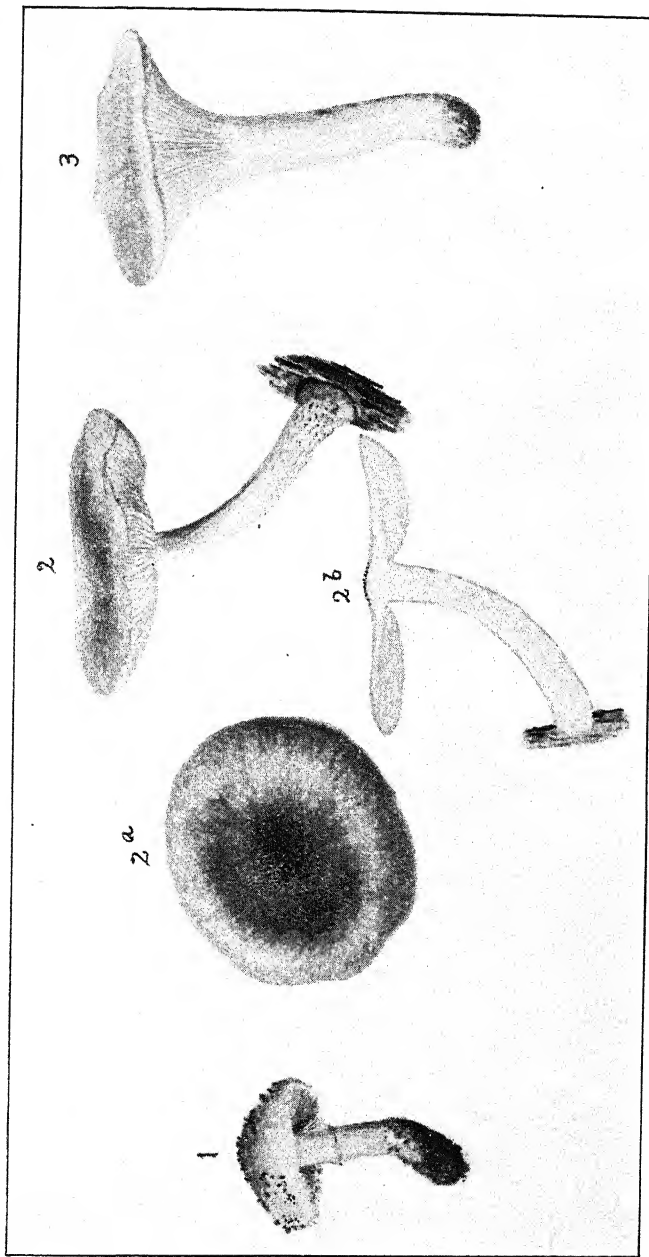
COLLYBIA MACULATA



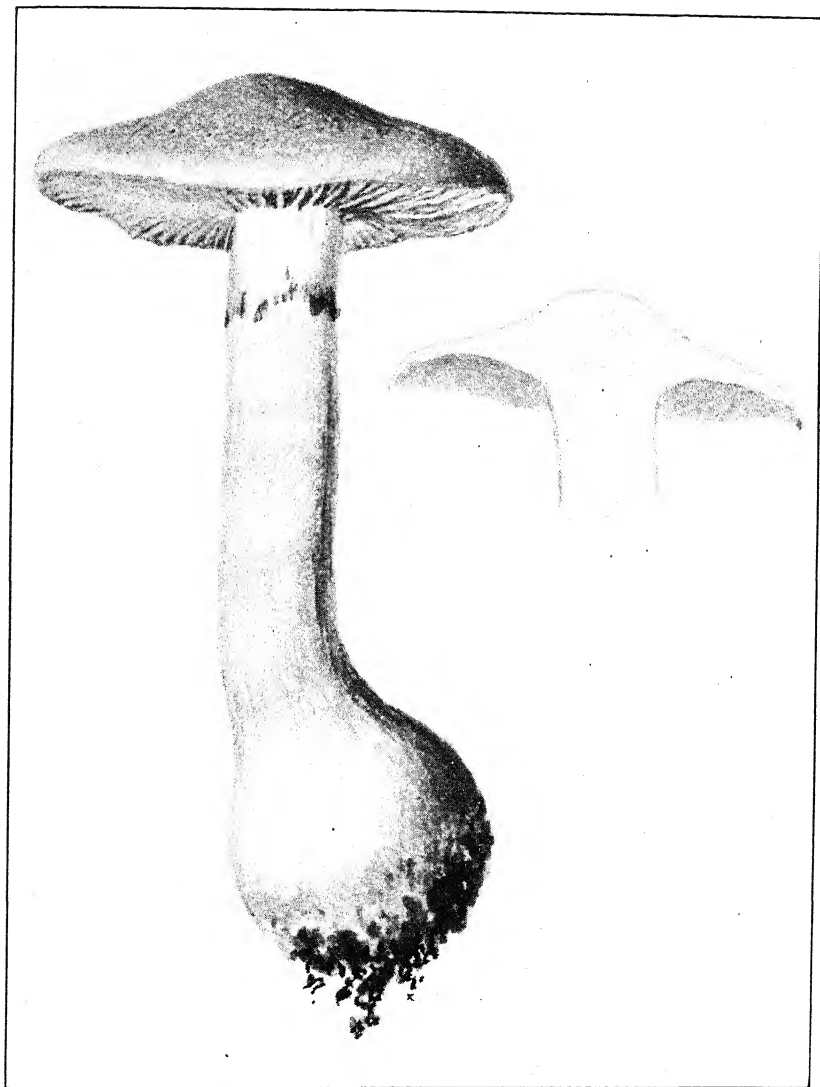
1. AMANITA CORTICELLI
2. AMANITA CRASSIVOLVATA



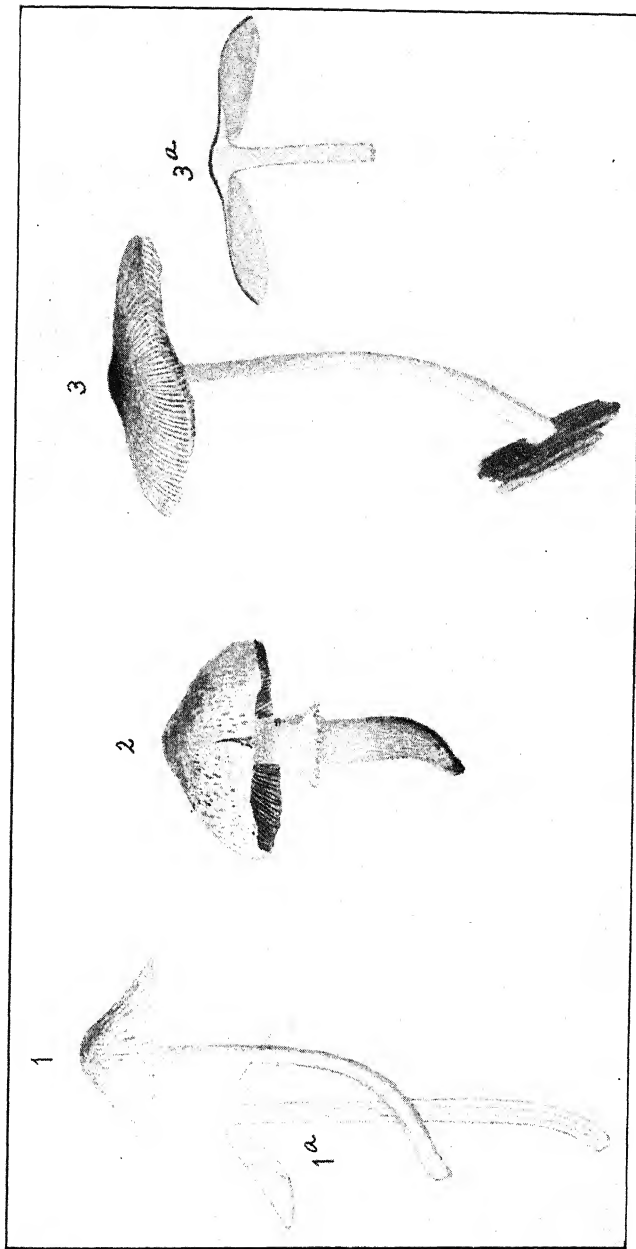
TRICHOLOMA SEJUNCTUM VAR. RUBROSCABRUM



1. *STROPHARIA AERUGINOSA* VAR. *EXQUAMOSA*
2. *PLUTEUS SALICINUS*. 3. *HYGROPHORUS PROXIMUS*



CORTINARIUS RUBROCLAVUS



1. MYCENA INCONSPICUA. 2. AGARICUS AURICOLOR
3. PLUTEUS LEONINUS VAR. OCULATUS

AN INTERESTING DISCOVERY OF A RARE SLIME-MOLD

ROBERT HAGELSTEIN

Enerthenema Berkeleyanum Rost. is one of the rarest of the Mycetoza, or slime-molds, so rare, indeed, that but two occurrences have heretofore been recorded. It differs mainly from *Enerthenema papillatum* (Pers.) Rost., the only other species of the genus, in that the spores are clustered while in the latter species they are free. Several minor differences also exist.

The form with clustered spores was first recorded by Berkeley and Broome (Ann. Mag. Nat. Hist., II. 5: 366) as occurring on boards from South Carolina. Rostafinski (Mon., App. p. 29, 1876), referring to this collection, which probably he had seen, established the species principally on the difference in spore structure. As Berkeley and Broome's description was not quite clear, Lister (Mon. Mycet. Ed. 2, p. 161, 1911), after an examination of the original specimen in the Kew Herbarium, concluded that the earlier students had been in error, and had mistaken the clustered spores of a parasitic fungus to be those of the slime-mold.

The existence of an *Enerthenema* with clustered spores was therefore in doubt until Sturgis (Myxo. Colo., II, p. 448, 1913) recorded from Colorado a second gathering, which he named *Enerthenema syncarpon*, discarding the name of Rostafinski. In the last edition of her work (Mon. Mycet. Ed. 3, p. 150, 1925), Miss Lister includes both gatherings as varietal to *E. papillatum*, with the variety name *syncarpon*.

For several years, the writer has been collecting the Mycetoza growing in the vicinity of his home at Mineola, Nassau County, New York. In this work he has been assisted by Mr. Joseph Rispaud, an architect and builder, to whose keen eyesight was due the discovery of many rare or minute species. In the latter part of July 1926, while Mr. Rispaud was examining the spruce lath, recently nailed on the inside of the walls of a building he was

erecting in Mineola, he noticed on one of them what appeared to be a slime-mold. Examination with a hand-lens proved it to be an *Enerthenema*, and on going through the unused lath, many additional specimens were secured. White plasmodium was also present, and this fruited rapidly to maturity after removal to the writer's laboratory.

Study with the microscope revealed an *Enerthenema* similar to *E. papillatum*, but with spores in clusters of from four to eight or more. The spores measured from 12 to 13.5 μ in diameter. They were larger, darker, and more strongly spinulose than in *E. papillatum*. The sporangia were smaller, from .25 to .65 mm. in diameter, with shorter stalks, and more widely separated in habit. Generally, these are characters of the earlier gatherings.

An effort to trace the history of spore germination, and the growth of the plasmodium, which evidently did not occur at Mineola, resulted in the information that the lath had come from Nova Scotia. As the lath arrived on railroad cars only two days before the fruitings were observed, it is probable that germination occurred in Nova Scotia, the plasmodium feeding and growing on the fresh lumber there, and in transit.

This additional occurrence of an *Enerthenema* with clustered spores seems to make it unreasonable to further assume that Berkeley and Rostafinski, both distinguished students, should have erred in their observation of spore clusters in Berkeley's specimen. The question remains, is the character sufficient for specific distinction? In the genus *Badhamia*, the character is generally recognized as such. If so there, why not in the genus *Enerthenema*, and particularly as in this case we have other differences, of sporangium size, spore size and color, habit and possible habitat.

The writer agrees with Macbride (N. Am. Slime-Moulds, Ed. 2, p. 190, 1922) that *Enerthenema Berkeleyanum* Rost. is a distinct species, and by rule of priority should bear Rostafinski's name.

Specimens of the recent collection have been placed in the Herbarium of the New York Botanical Garden.

MINEOLA, NEW YORK

NOTES UPON REVIVING OLD CULTURES

ALFRED POVAH

The mere mechanics of keeping living cultures in the laboratory for any considerable time entails so much labor that scientists, busy with research or teaching or both, are forced to make one of two choices, *i.e.*, to turn over the work to an assistant or else allow the culture to die. Unfortunately, the first of these choices often brings about the same result as the second, for fungi vary considerably with regard to their ability to retain vitality in culture. On the one hand there are those exacting ones, like *Sporodinia grandis* Link, which require transferring about once in a fortnight; on the other, there are those fungi which may be neglected, as *Aspergillus Oryzae* (Ahlburg) Cohn, which can be allowed to go six months between transfers. Often the vagaries of a fungus are learned only by sad experience. Any means, therefore, of obviating transfers should be of assistance to many workers and thus the writer feels that this note may justify itself.

About two years ago repeated transfers of mycelium and sclerotia from an old culture of *Sclerotium Rolfsii* Sacc. gave no growth. As a last resort, before discarding the culture, hot agar was poured into the test tube. Within a few seconds the old dried sclerotia began to swell and in less than a minute became normal in size. The tube was then slanted and after cooling was placed in an incubator at 28 degrees C. In forty-eight hours abundant mycelium had developed and new sclerotia were beginning to form. It has been found that better results are obtained when a slight amount of agar is added, as growth rarely starts on the deeply submerged part of the fungus.

Since this first experiment the same procedure has been tried out on over a hundred cultures varying in age from three months to five years. In approximately forty per cent of these experiments growth has been resumed. By this method growth was obtained from a culture of *Sporodinia grandis* Link after five months, from a *Mucor* culture two years old and from a culture of

TABLE I
CULTURES SHOWING GROWTH AFTER ADDING HOT AGAR

Fungus	Age of Culture in		
	Yrs.	Mos.	Days
<i>Absidia</i> sp.		10	8
<i>Aspergillus Oryzae</i> (Ahlburg) Cohn	2	10	19
<i>Aspergillus Oryzae</i>	4	6	18
<i>Botrytis</i> sp.		10	6
C 2 (1)		8	29
C 3 (1)		8	29
C 7 (1)		8	29
C 17 (1)		8	29
<i>Fusarium</i> sp.	1	10	11
<i>Fusarium</i> sp.	1	11	22
<i>Hypoxylon</i> sp. (?)		8	15
<i>Hypoxylon pruinaum</i> (Klot.) Cooke	1	0	1
<i>Hypoxylon pruinaum</i>	1	10	7
<i>Mucor christianiensis</i> Hagem		3	3
<i>Mucor christianiensis</i>		7	17
<i>Mucor circinelloides</i> v. Tiegh.		3	3
<i>Mucor circinelloides</i>		6	8
<i>Mucor griseo-cyanus</i> Hagem		3	3
<i>Mucor griseo-cyanus</i>		6	29
<i>Mucor hiemalis</i> Wehmer		3	3
<i>Mucor hiemalis</i>		7	12
<i>Mucor parvispora</i> Kanouse		10	8
<i>Mucor Ramannianus</i> Möller		10	8
<i>Mucor Ramannianus</i>	1	1	8
<i>Mucor</i> sp.		7	0
<i>Mucor</i> sp.		5	16
<i>Mucor</i> sp. (2)		10	8
<i>Mucor</i> sp.	2	3	24
<i>Mucor</i> sp.	2	7	26
<i>Mucor</i> sp.		1	18
<i>Mucor</i> sp. (2)		2	6
<i>Mucor</i> sp. (2)		3	20
<i>Penicillium</i> sp.	2	10	17
<i>Peronospora effusa</i> Rabenh.		3	15
<i>Phycomyces nitens</i> Agarth (3)		3	18
<i>Phycomyces nitens</i> (3)		2	6
<i>Phycomyces nitens</i> (2)		2	2
<i>Phycomyces nitens</i>		7	19
<i>Pythium</i> sp.		11	6
<i>Rhizopus nigricans</i> Ehr. (—)		10	8
<i>Rhizopus nigricans</i> (—)		11	6
<i>Rhizopus nigricans</i> (+)		3	28
<i>Rhizopus nigricans</i> (—)		6	28
<i>Rhizopus nigricans</i> (—)		7	26
<i>Sclerotinia Erythronii</i> Whetzel (4)		11	5
<i>Sclerotium Rolfsii</i> Sacc.	4	6	9
<i>Sclerotium Rolfsii</i>	5	5	14
<i>Sporodinia grandis</i> Link.		5	6

(1) Unidentified fungus isolated from *Cornus stolonifera* Michx.

(2) Two cultures.

(3) Three cultures.

(4) Identified by H. H. Whetzel.

Sclerotium Rolfsii over five years old. The writer does not wish to imply that this method can be relied upon but it is one that should be resorted to before old cultures are discarded. Some positive results are given in table I.

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NOTES AND BRIEF ARTICLES

BRESADOLA'S ICONOGRAPHIA MYCOLOGICA

In the opinion of Ellis, Peck, Lloyd, Weir, Overholts, Murrill, Kaufmann and many others, the Abbot Giacomo Bresadola is considered the greatest living authority on higher fungi. For this reason his name needs no introduction to the mycologists of America. To quote his own words, it is in the United States of America that he has found his greatest admirers and his best friends.

For the last fifty years G. Bresadola has dedicated all his time to the study of this one subject and in more than sixty publications (books and articles) has presented the fungi not only of all Europe but also of Camerun, Borneo, Java, the Philippine Islands, Australia, Patagonia, Brazil, Porto Rico, and the United States.

With his many and successful efforts to coördinate and simplify the systematic study of the fungi, Bresadola is carrying on the work of Fries and Persoon and may be considered the worthy successor of these great masters.

As a tribute of admiration to Bresadola on the occasion of his 80th birthday, the Italian Botanical Society has undertaken the publication of "Iconographia Mycologica." This work will consist of a summary of the observations of Bresadola and will comprise twenty volumes with a total of one thousand plates.

Three volumes are published and contained one hundred plates of "*Agaricae leucosporae*" (*Amanita*, *Lepiota*, *Schulzeria*, *Armillaria* and *Tricholoma*). The plates are reproductions in color of paintings made mostly by Bresadola. A few are painted by other artists under his direction. All are real works of art and are excellently reproduced. Each plate is accompanied by a clear, terse description in classical Latin, the universal language.

When the announcement of this book was sent out, the publishers received many subscriptions from every part of the world: from Japan to Brazil and from Sweden to South Africa. The

number of subscribers in the small cities in the province of Trento (Italy) alone was sixty-eight. From the United States of America up to March, 1927, only fourteen persons had subscribed.

In a country like the United States, where there is such a keen interest in the study of botany, it is difficult to understand why a publication of this kind has aroused so little interest. Possibly the meagre response can be explained by the fact that not sufficient publicity has been given to this work. Probably the schools, libraries and laboratories of America have not realized that this work is being published and that three volumes are already out and the fourth almost finished.

It is not only as a tribute to the modesty of the man or to the geniality of the author that this book should be acquired, but especially because it is a publication of supreme value, and will be a priceless asset in any collection of books on the subject.

Subscriptions may be sent to: Prof. G. B. Trener, Director of the Museum of Natural History, Trento (Italy), or G. E. Stechert, 31 E. 10th St., New York City. (Price \$6.00 per volume.)

CARLO SAVINI

The Canadian Phytopathological Society will hold its winter meeting at Winnipeg in December, at which time Dr. J. C. Arthur of Purdue University will give an address.

MYCOPHAGIC NOTES

On the 19th of last September, 1926, I found a fair-sized Noctuid larva apparently feeding on the gills of a "death-cup," *Amanita verna*, into which it had eaten a cavity about twice the size of its head. I carefully boxed the fungus with the larva and brought it home to keep it under observation. To preserve the freshness of the fungus the box was put in a cool place—part of the time in a refrigerator. By the morning of the fifth day nearly a quarter of the gills had been rather superficially eaten over. The larva that morning was particularly active and persisted in attempts to get out of the box. In the evening it had half concealed itself between the volva and the stem of the fungus and was beginning to construct a cocoon. In November, I sent the pupa in its little volva house to Mr. J. J. de Gryse, Entomologist of the Canadian Division of Forest Insects. He writes me that on the 26th of January it emerged—a perfect specimen of *Chytonix palliatricula*. Apparently it had thriven on its death-cup diet. Can the physiologist explain how it is that a substance fatally toxic to frogs and higher animals is innocuous to the cutworm?

JOHN DEARNESS

LONDON, ONTARIO

THE GREEN-SPORED LEPIOTA

There are found among the numerous forms of mushrooms, sometimes gathered from our fields for table use, a few species that for some peculiar reason produce varying effects upon different people. The *Lepiota* which passes most commonly under the name *Lepiota Morgani* Peck, is one of these. This large and very striking plant has been described by some mycophagists as of excellent flavor and to be highly recommended. Others have eaten it with decidedly harmful consequences. The diversity of opinion that has developed has led to many trials, followed by enthusiastic approval or a call for the doctor, and further disagreements as to its use as a food. These will doubtless continue

till more is known about the fungus. From the numerous discomforting results it is evident that even the omnivorous consumer of the succulent dish must use care and discretion.

This species has long been considered a resident of our middle states that has wandered southward, and extended its abode to the warmer and congenial climate of our American tropics. As a matter of fact, it was first described by Meyer in 1818 from material gathered in the valley of the Essequibo, in British Guiana, under the name *Agaricus Molybdites*. For this reason it may be known as *Lepiota Molybdites* as well as *Lepiota Morgani*. Or, if one prefer placing it in a genus by itself because of its spores which are green at maturity instead of white, its name becomes *Chlorophyllum Molybdites* or *Chlorophyllum Morgani*, depending on whether the American or International Code is followed. Masseé has also described the same mushroom as *Lepiota esculenta*, the edible *Lepiota*, from British Guiana. This, however, is not all the story, for Copeland (Ann. Myc. 3: 28. 1905) also described the fungus, under the name *Lepiota chlorospora*, from the Philippine Islands, and but recently it has been reported by Parks (Univ. Cal. Publ. Bot. 12: 53. 1926) under Copeland's name, from the Mahina District of Tahiti, where specimens were collected by Parks and Setchel in May, 1922. The species is unquestionably a native of the American tropics and the tropical islands of the Pacific. Like a number of other plants among the fungi, as well as seed-producing forms, it has spread from its original home, and is now found farther north in localities favorable for its maturity.

During the month of August, 1912, I collected a number of specimens of this species on the open grassy lawn of the Lunetta, the Paseo of Manila, in the Philippines. On showing them to Dr. Copeland a few days later he told me they were identical with the species he had described as *Lepiota chlorospora*, and that they corresponded in all characteristics with his type material, which had been destroyed. The plants were growing in great profusion, forming large conspicuous fairy rings, the most perfect examples of this condition that I have ever seen. There were small rings but a few feet across and larger ones fully a rod in diameter. The grass within the circles was of a much darker

green than that outside, so that the areas were markedly conspicuous for some distance. The fungus was certainly at its best.

A party of four, desirous of having a mushroom meal, requested me to gather them sufficient of this particular kind. Copeland's description had included the statement that they were among the edible forms of the Islands, and but few species from the locality had been tested for this quality. It was with some hesitancy, and only after a warning, that I consented to procure material for the dinner. As the supply to choose from was so plentiful the gathering was restricted to plants of some size but with the pileus only about half expanded, a condition in which the spores were not mature and the gills still white or light colored. There were no specimens of any other species in the collection.

The next day I received a report on the meal and its consequences. Though described from the Islands as edible, the fact that few had been adventurous enough to try them added interest to the results. The person who had requested me to gather the mushrooms said that, so far as he was concerned, they were delicious and he had thoroughly enjoyed his meal, feeling no after effect of any kind. The other three had agreed during the meal that the mushrooms were of excellent flavor and that they had enjoyed eating them. It was not till later that gastronomic differences of opinion became manifest. One of the three felt some slight inconvenience but nothing very serious. He would have thought little of it, deeming it no more than a passing indisposition, probably a light attack of indigestion, if it had not been for the other two members of the party. The third member of the group was rendered quite ill, and it was feared for a time that the fourth might not live through the night, the effect upon him was so serious. By the aid of a doctor, however, he pulled through, and though weak from the effects was about again in a day or so.

In those cases of more mild effect, but severe enough to receive serious consideration, it is found that the first symptoms become evident from one to two hours after the mushrooms have been eaten. The first to make their appearance are dizziness followed by an uneasiness of the stomach. Sudden violent vomiting follows, the attacks of which may be repeated at intervals for about

two hours or slightly longer. Each of these vomiting periods is preceded by a marked attack of cold sweat. Through the time occupied by the attacks of intermittent vomiting, and alternating with them, occasional chills are felt. A haziness or foggiess of the brain occurs throughout this period. Following the vomiting period a diarrhoeic attack occurs. This is usually of longer duration, and may last from three to four hours. After this, recovery to a normal condition may be rapid and no further effects felt.

In the more severe cases, such as that of the fourth person mentioned above, the same symptoms make their appearance. They show, however, a marked distinction. Instead of following one another as a sequence of events they are overlapping. They are also more violent, and may last for a longer time. Vomiting and purging may occur simultaneously or alternately, and are accompanied by alternating cold sweats and chills. Haziness of the brain and dizziness are more pronounced. The length of this attack depends upon the person and the amount eaten. As a result the patient is left in a very weak state. Recovery, however, seems to begin immediately after the thorough elimination of the contents of the alimentary tract. In spite of the violence of the case, no serious after effects are felt, and the recovery of the patient is complete.

The total immunity of some and the severity of the results upon others is hard to explain. As to the poisonous nature of this species there can be no doubt. Those who claim to have eaten this agaric with enjoyment and without later inconvenience are inclined to associate the trouble of others with their physical condition rather than lay the blame to the fungus. The probability is that the reverse is true. Those not affected are either resistant to or capable of counteracting in some manner the small amount of harmful toxin present. The symptoms certainly suggest a toxic action though the system is able to throw it off, and after the inconvenience has passed no further results are felt.

The genus *Lepiota* has, without a question, a close relationship with *Amanita*. In *Amanita* poisoning we find added symptoms and greater severity, but there seems to be at least a suggestion that the types of poisoning have something in common. *Lepiota* poisoning suggests a condition of intoxication and, at least in its

earlier stages, such a condition has likewise been suggested for *Amanita*. In fact a species of *Amanita* has been used in Siberia for the production of an intoxicating beverage. When used in this form it does not seem in the habit of causing fatal results, though *Amanita muscaria*, one of the most deadly species, is used. It might be pointed out that *Amanita* also includes edible species, but probably not as many as the genus *Lepiota*. Fortunately, so far as I am aware, no fatal consequences have been reported as having resulted from eating the green-spored *Lepiota*.

PAUL W. GRAFF

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